POWER

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Try!

MOST of the good things are found out, most of the real achievements perfected, when one is actually at work on something.

Many a task has been shirked, many an opportunity for useful accomplishment and progress passed up because one could not see one's way through it.

It is only the ordinary routine repetitive tasks that can be plodded through mechanically, the logical outcome apparent from the beginning.

But there are things that must be worked out in the doing, ideas and expedients that will be suggested as the work progresses, steps that will follow naturally upon those already taken that would not develop in an abstract process of thinking it over.

I do not mean that one should go blunderingly into a job without bringing to bear upon his plan of attack all the knowledge and experience and ingenuity at his command, but he will often find that the solution is one that had to be worked out, not thought out, and the result and the path to its accomplishment may be quite different from anything that he had in contemplation when he started actual operations.

What I am endeavoring to emphasize is the suggestiveness, the animating quality of effort and activity; the ways of doing things that come to those who try.

The man who tries may fail. The task may be impossible or beyond his capabilities, but in making the effort and putting the best that there is in him into it, he ranges himself with those who are doing the work of the world.

The Power and Heat Problem of a Roofing Felt Mill

By K. B. HOWELL
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IN COMMON with other types of paper mills, the power problem of the mill manufacturing roofing felt is essentially a determination of the most economical feasible layout which will supply the combined requirements of process steam and mechanical power. In the relationship of its process steam to mechanical power, the mill manufacturing roofing felt occupies a somewhat intermediate position between that of the high-grade paper mill, whose demand for power is relatively high in proportion to the process steam requirement, and the box board mill, where this condition is reversed. A somewhat unique feature of the roofing felt mill, however, is its frequent location adjacent to the consuming roofing plant with the consequent necessity of a power plant design that is adapted to the combined requirements for steam and power of the two plants.

Variation in the requirements of roofing plants under local conditions makes difficult any attempt to express the combined requirements in a generalized form; and, in fact, even in the case of the separate felt producer, certain local condition in the way of types of product may restrict somewhat the rigidity of a generalization. However, the requirements for power and process steam can be fairly closely expressed for the felt mill of average size, well designed and managed, and it is felt that such an expression should prove helpful in the design of new mills or the review of existing installations.

FULL load plant costs do not tell the whole story. Actual variations in load have a large influence. The author shows how the most expensive plan on the full-load basis may prove cheapest for actual conditions. A similar study should be made for every plant change.

The energy requirement of such a well-designed, well-operated mill of average size, engaged in the manufacture of normal grades of roofing felt, are about as shown in Table I, the electrical energy consumed being measured at the electrical power generating source and no allowance being made for building heating loads.

While the figures shown in this table are normal average requirements and readily realized in a number of mills, they presuppose reasonably efficient use of power, a condition not being realized in many of the present producers. In designing the power plant from the foregoing average requirements, it is naturally necessary to allow for peak variations from the average load and to take account of the effect produced by variability in products run. It is found that with normal grades of product in current trade demand a design allowing for a 40 per cent peak above the figures given represents safe proper practice.

When it comes to determining the power system to be used to meet these outlined requirements, the individual and local questions of fuel cost, labor rates, investment charges, serviceability, expansibility, relative obsolescence, etc., play such a large part as to preclude generalization. Existing mills now show substantially all recognized types of power generating layouts from the non-condensing engine with belted lineshaft drive to the more modern electric generation through hydro, Diesel or bleeder turbine arrangements. Three of the most commonly promising types for employment under present-day conditions are the following:

1. The generation of power through a turbine generator of bleeder type, bleeding preferably in two stages at 50 lb. and 5 lb. gage pressure, quantity of bleed controlled to take care of requirements for driers and hot-air absorption systems.

2. Generation of power through Diesel engine with separate provision for process steam.

3. Purchase of public utility power with separate provision for process steam.

In the two latter cases it is commonly necessary to allow for the power capable of development as the result of the expansion of the process steam from boiler pressure to pressure of process use. This can usually be effected most feasibly by back-pressure engines or by back-pressure turbines driving induction generators or alternators swung across the main power line and exhausting at the process steam pressure.

Specific Computations Relating to a Recent Design

The cost calculations applying to these three types of power generation in a layout recently designed for a 48-ton roofing felt mill may be of general interest. Good steam coal of 13,500 B.t.u. heat value was available at $4 a ton delivered in bins, crude oil at 4½c. a gallon delivered in storage tanks, with a good quality Diesel lubricant available at 45c. per gal. Attendance labor, expense charges, taxes, depreciation, interest and insurance were liberally figured but carefully adjusted to the requirements of each power plan. In Plan No. 1 all power was purchased except that required for driving the wet and dry ends of the felt machine which was obtained from separate back-pressure engines exhausting at 50 lb. back pressure to the driers. Boiler pressure of 150 lb. was employed and additional drier steam was furnished through a regulating reducer valve. In Plan No. 2 conditions substantially similar were treated except that the power requirement was obtained from two Diesel units of 500 hp. each. In Plan No. 3 all mechanical power was furnished by a 1,000-kw. bleeder type turbine with an electric generator, the steam requirement from the driers and the absorption system be-

ing bled directly from this turbine. A more economical design for each of these plans might have been realized with higher boiler pressures and superheat, but the limit was imposed by the boiler plant of the adjacent roofing mill, which was not adaptable to ready alteration. The costs under the three plans are shown in Table II, for operation of the plant with its full output of 48 tons per day.

In comparing these figures, one must bear in mind that the total annual costs are largely influenced by the load factor of the mill, the ratio of the actual annual production to the plant capacity. Fixed charges are undiminished by plant shutdown or reduced production, and even operating charges do not decrease proportionately.

TABLE I—THE ELECTRICAL ENERGY AND PROCESS STEAM REQUIREMENTS OF AN AVERAGE MILL

Departmental Operation	Normal Kw.-Hr. Required per Ton of Product	Normal Lb. Process Steam per Ton of Product
Cutting	8	.....
Beating	200	.....
Machining	80	5,000 (Driers) 2,000 (Hot Air Absorption System)
General service (hoists, machine shop, water supply, etc.)	25	.....
Total	313	7,000

Even so, the costs quoted in Table II are an excellent example of the economies possible when process steam is required together with electrical energy. From Table I the electrical energy and the process steam requirements for an average mill are seen to be 313 kw.-hr. and 7,000 lb. respectively per ton of product. Allowing 1½c. per kw.-hr. for the electrical energy and 20c. per thousand pounds for the process steam, the cost per ton of output would be $5.31. Both of the assumed rates are low, and the fact that $5.31 is a higher unit cost than is anticipated under any of the suggested plans indicates that all three represent good design.

TABLE II—COST OF ELECTRICAL ENERGY AND PROCESS STEAM IN 48-TON MILL

	Mainly Purchased Power	2—500 Hp. Diesel Engines	1—1000 Kw. Bleeder Turbine Generator
Investment required	$21,641.	$89,641.	$65,800.
Investment per ton of daily output	451.	1,867.	1,371.
Daily operating costs:			
Cost of fuel or purchased power	222.22	136.89	129.60
Attendance labor	15.	24.	21.60
Repairs and expenses	5.74	11.44	14.60
Fixed charges	10.82	44.82	32.90
Total daily operating cost	$253.84	$217.15	$198.70
Electrical energy and steam cost per ton of output	5.29	4.52	4.14

Under the conditions encountered the Diesel engine was found to be higher in both operating and investment cost than the bleeder turbine. While it will be seen that the purchase of outside power gave the highest daily operating charge, yet the relatively low investment cost, the more ready adaptability to change, and moderate expansion, and the lessened fixed charge burden in periods of reduced operation or shutdown made this plan worthy of serious consideration. After due weighing of all factors, tangible and intangible, Plan No. 1 embracing this purchase of outside power was determined upon as most suitable for the mill in question.

Application to Existing Mills

The greater portion of this discussion is naturally concerned with power plant plans for a new mill, but it is hoped that it is of a sufficiently general nature to form a helpful basis for consideration and general appraisal of existing layouts. The power expenditures of present mills are in the main excessive, varying somewhat widely but averaging in many mills about 50 per cent in excess of what may be accomplished with a carefully designed power plant efficiently operated. Much of the excess expenditure results from inefficiencies of layout and equipment and can usually be corrected only at considerable investment cost. Some of it is, however, resultant from wastage in power consumption, and even in the power generating features many corrective measures can frequently be taken, which, while not realizing ideal economy, provide very considerable improvements over present practice at a moderate cost. With a present indication of keener future competition in roofing felt manufacture, the problem of the power expenditure in operation is becoming increasingly important and will more and more occupy the attention of the mill management in the future.

Good Housekeeping in the Power Plant

By Carl Wildey

Articles on progress for young engineers written by more experienced chief engineers, nearly always allude to study of the mechanical problems confronting them every day. Very little is said on the subject of "good housekeeping."

The average power plant is looked upon by the outsider as a place full of coal dust and grease, and the average engineer is thought of as an unkempt looking individual in overalls, with an oil can in one hand and a soiled rag or piece of waste in the other.

Personal characteristics count as much today as loyalty, and loyalty counts much. No engineer can be clean in the engine room and dirty personally, and a great deal of depreciation in machinery and repairs could be stopped if the machinery was kept sufficiently clean to check rust and chemical action. One large manufacturer has all the machine parts nickel plated, and gives as his reason for this extra expense that a nickel-plated part receives attention and does not depreciate nearly so fast as one merely painted with a number of coats of paint, probably over a rusty surface originally. It has been found that nickel-plated nuts do not rust out, and the threads on the studs or bolts do not deteriorate by corrosion, as is the case with common material.

In turbine casings, using high pressures and temperatures, nickel-plated studs can be removed much easier than the common ones. This holds true with steel as well as wrought-iron studs and again illustrates that "good housekeeping" in a power house means long life to materials. The man higher up will notice a clean place and a clean employee with exactly the opposite thought in mind to that he has when he sees a dirty place and a soiled looking man, and if our engineers would make it a rule to keep packing, oil, coal samples, wrenches, log sheets, charts and miscellaneous parts out of sight, and leave their desks neatly arranged, managers would know that the rest of the plant was being kept in clean, workable condition.

With 12 per Cent CO_2 in the flue gas, 1 per cent CO represents a loss of 800 B.t.u. per lb. of carbon burned, or about 500 or 600 B.t.u. per lb. of coal. The efficiency as a result is 4 or 5 per cent low.

New Johns Hopkins Heating Plant Is Model of Completeness

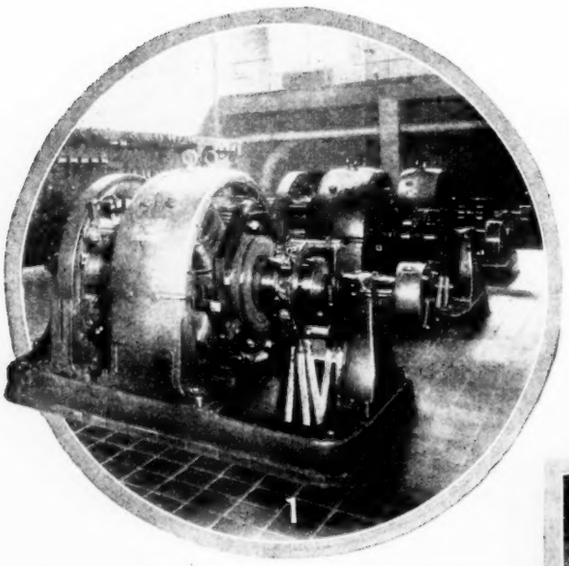


Fig. 1—Three 220-kw. rotary converters are used in a substation designed for the utmost reliability

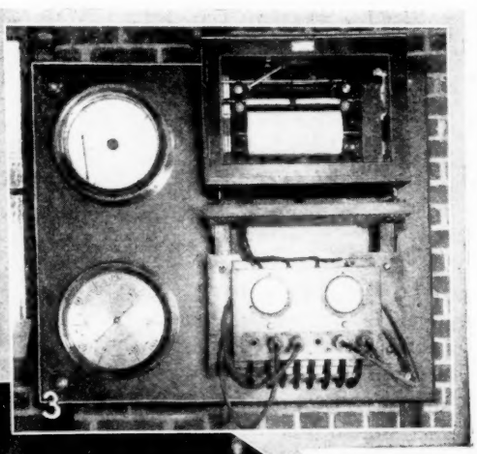


Fig. 3—Board in engineer's office carries electrical CO_2 recorder, also steam pressure gage and recorder

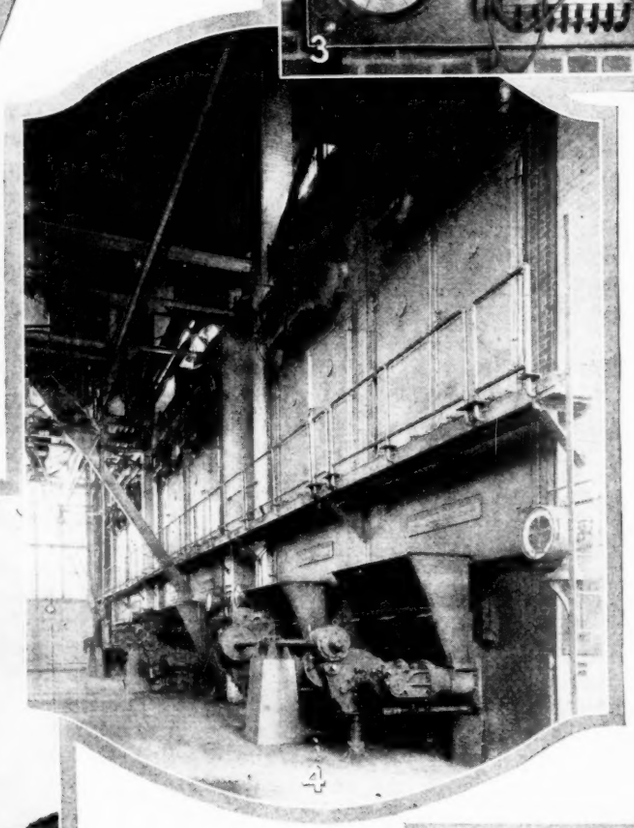


Fig. 2—General view of plant—the mechanical heart of a world-famous medical center

Fig. 4—There are six 4,570-sq.ft. water-tube boilers with motor-driven stokers

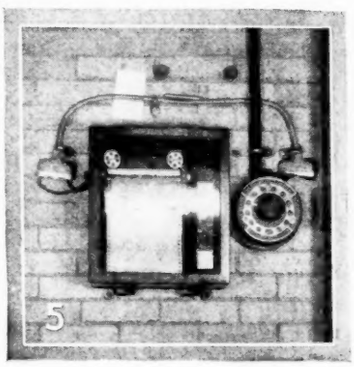


Fig. 5—Flue-gas pyrometer with twelve-point switch

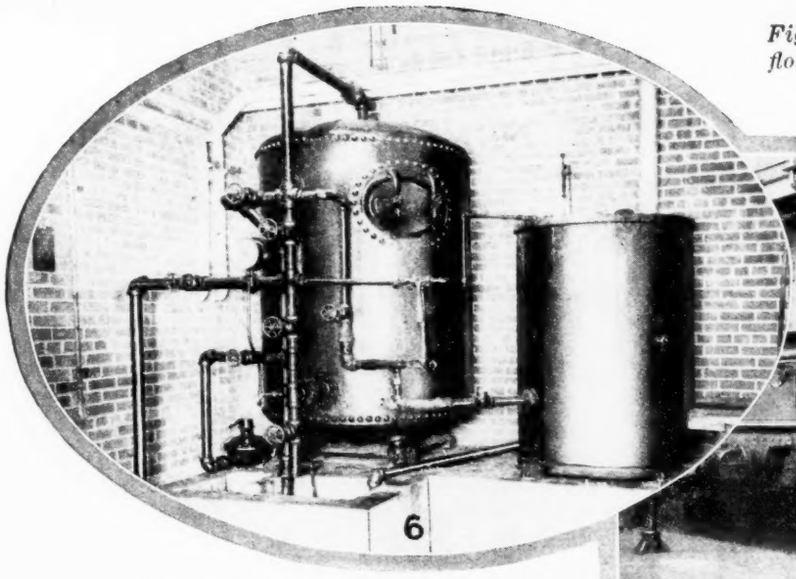
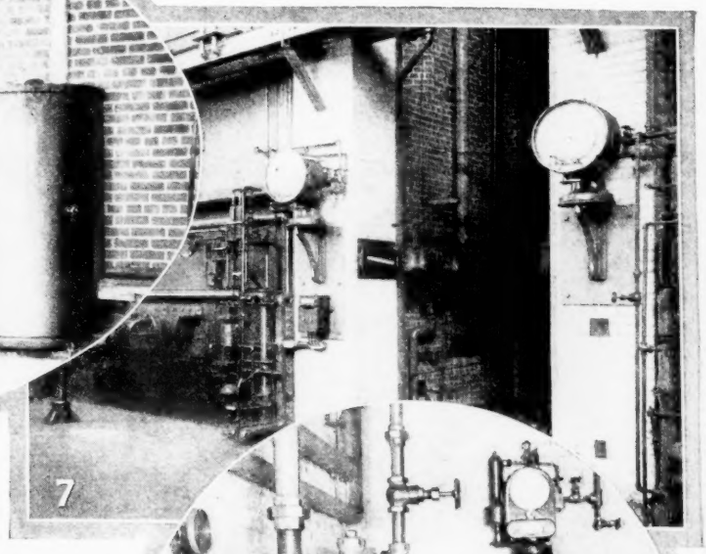


Fig. 6—Zeolite water-softening plant

Fig. 7—Boilers are equipped with steam-flow meters, draft gages and electrical CO_2 indicators



THESE two pages will carry the reader on a pictorial trip through the recently completed heating plant and substation of the Johns Hopkins Hospital and the Johns Hopkins University Medical School in Baltimore. No expense has been spared to make this plant a model in every respect. The instrument equipment includes eight steam-flow meters, three electrical CO_2 indicators and one four-pen recording instrument, six draft gages and one twelve-point recording thermometer. Two of the boilers are fully equipped to burn oil, and two others can be changed over on short notice. The plant is under the supervision of George Doenges, Supt. of Buildings.

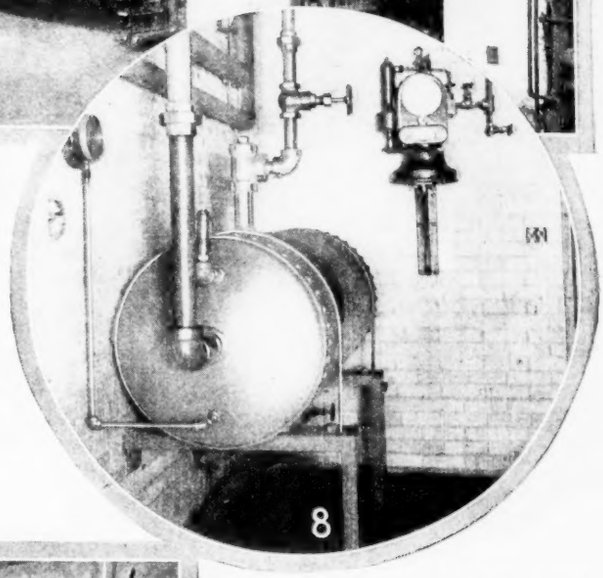


Fig. 8—Steam meter to hospital

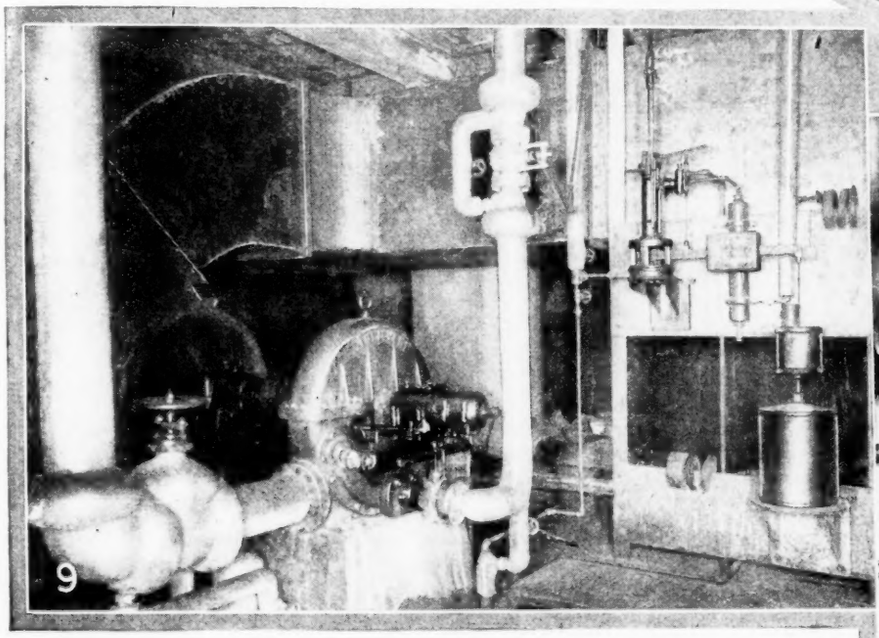


Fig. 9—One of three forced-draft fans showing turbine drive and automatic regulator

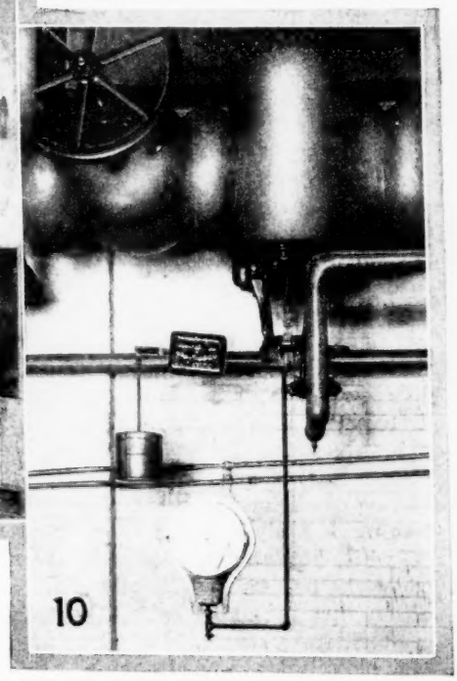


Fig. 10—Reducing valve and pressure recorder on line to hospital

Successful Sampling Lines

Little Things That Spell the Difference Between Success and Failure In Sampling Lines to CO_2 Recorders

BY CHARLES C. PHELPS

MANY a good CO_2 recorder has been condemned because of an improperly installed or neglected sampling line. The writer has visited scores of plants where slight changes in the sampling line have eliminated 80 or 90 per cent of the attention formerly required

If the flue gas were dry and clean, it would introduce few complications, but unfortunately it is always laden with soot and dust and almost invariably is saturated with moisture. Besides, intensely corrosive sulphur impurities are usually present in small quantities.

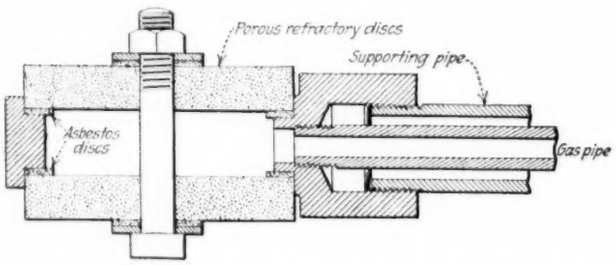


Fig. 1—Porous refractory disks located on end of sampling line inside setting may be used for filtering gases

An efficient soot filter is a prime necessity not only to avoid fouling the CO_2 machine, but also because clean gas permits the use of a smaller-bore sampling line, which in turn decreases the lag.

Two general types of filters are available—those located within the hot setting on the intake end of the gas sampling line, and those installed in the line outside of the boiler. Fig. 1 shows the cross-section of a filter of the first class, which consists essentially of two replaceable porous refractory disks that pass the gas but exclude dust and soot. A heavy deposit of soot on such a filter does not interfere with gas flow, because the soot deposit in itself is an excellent filtering medium when hot and dry. Such filters commonly are in service for months and even years without attention.

Two conditions may interfere with the proper functioning of a filter of this type. First, the impingement of white-hot particles of ash against the disks may cause the pores to fill and the disks to seal over, a condition that might be caused by retarded or secondary combustion. Second, if a jet of wet steam, as from a soot blower, is directed against a filter that is covered with cement-like ash, a similar sealing action results Both of these conditions are decidedly unusual, but when they have been encountered they have been easily overcome by protecting the filter with shields. The older and less efficient type of filter installed outside of the boiler has the disadvantage that the cotton waste or cloth in it must be replaced frequently and that the line between it and the boiler must be blown out occasionally. With a good refractory filter it should never be necessary to blow out the line.

Line Drainage of First Importance

The sampling line must slope all the way from the end of the line in the furnace to a drain. Pockets or sagging sections in the line must be avoided. These are probably the most important rules and the ones most frequently violated in practice.

Engineers often wonder where all the water in the line comes from. The moisture in the air plus that in the fuel can account for but a small part of the condensate formed. Most of it comes from the hydrogen in the fuel which burns to water vapor. One part by weight of hydrogen unites with eight parts by weight of oxygen, forming nine parts of water vapor. Thus if a pound of fuel oil contained 0.11 lb. of available hydrogen, it would form 0.99 lb. of superheated water vapor upon burning—approximately as much water as fuel. This water vapor would nearly all condense in the line when cooled down to room temperature.

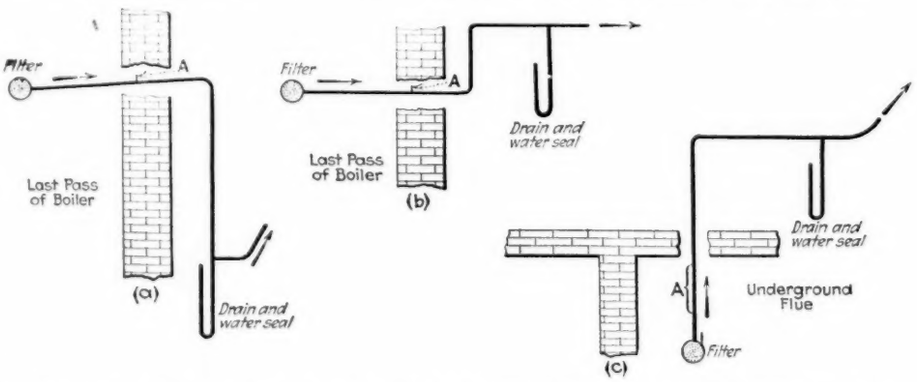


Fig. 2—Common faults in locating drain and water seal in gas sampling line. In each of these cases condensate will collect between the filter and the bend. Clogging is usually worst in region A.

A drain should be placed in the line at the lowest point and preferably in a relatively cool spot. A U-bend filled with water is the most convenient form of drain seal. The water which continually condenses in the line can usually be depended upon to keep the seal full after starting.

Fig. 2 shows lines improperly installed at the boiler end. In *a* the fault is that the horizontal section within the boiler slopes back to the filter. Engineers often

argue that such a section of pipe within the boiler is too hot to condense moisture. That is a mistaken idea because, even at relatively high temperatures, some condensation can occur. The conditions at *b* are even worse, because condensed water is practically certain to be trapped in the pipe at the left of the vertical rise.

If the pipe is installed as shown at *a* or *b*, there will eventually be a stoppage at point *A*, which is usually located about six inches inside of the outer wall of the brick setting. Presumably at about that point the condensate, trickling back, re-evaporates and leaves its salts behind in the form of a troublesome deposit.

The writer has, on several occasions, found sampling lines withdrawing gas from an underground flue as shown at *c*, with a drain seal placed high in the line. A seal in this location cannot prevent stoppage of the line at *A*.

If the sampling line is made of the right material and installed as shown in Fig. 3, sampling line stoppage should be permanently avoided. The cover that holds the sampling pipe in place permits easy removal of the filter through pipe *K* for inspection. The union permits breaking the line near the filter, and the cock *Q* permits testing nearly the entire line for tightness. The line is supported several inches away from the hot furnace wall, giving the gas a chance to cool and condense its moisture.

Brass or Copper Best for Sampling Lines

Brass is probably the most serviceable material to use for damp flue gas. The water flowing through it will gradually corrode it, but if it is sloped, the condensate will not have a chance to become so heavily charged with sulphur dioxide and the corrosive action will be very slow. Such a brass line ought to have a life of several years. The copper sulphite and sulphate which form are soluble in the condensate and hence drain away automatically in a sloping line. However, if there is a pocket in the line, these chemical substances will crystallize, preventing gas flow.

In assembling the line, care should be taken to remove all burrs left on the inside of the pipe by the pipe-cutting operation and to be sure that there is no dirt between the butt ends of the pipe in a coupling. The presence of either of these might form a pocket in a line even though properly sloped.

Iron pipe is also used for gas sampling lines, but it is inferior to brass or copper for the reason that the iron sulphate formed is insoluble and will gradually build up a deposit that will close the line, even though it is well sloped. When iron pipe is employed, a diameter several sizes larger than brass is usually specified simply because of this tendency of iron pipe to close up.

Lead would undoubtedly make an ideal sampling line if it were not for its temperature limitations and the difficulty of making tight joints. Rubber tubing is decidedly unsuitable for any part of a gas line because rubber absorbs sulphur dioxide to a marked degree and thereupon soon becomes brittle and cracks open, admitting air.

Preventing Galvanic Action

No matter what metal is used, an exceedingly important point is to have the line that is in contact with the damp gas entirely homogeneous; for example, if brass pipe is used, all fittings should also be of brass. If iron fittings are used with brass pipe, electrolytic action will be set up where the acid water comes in contact with the dissimilar metals.

Running a gas sampling line alongside a steam pipe or anything that retards condensation is objectionable. For the same reason it would be inadvisable to place the drain above or beside very hot brickwork. By careful selection the drain can be placed in a relatively cool place, even on the floor level if necessary.

Drying the Gas Beneficial

Fig. 4 shows a type of non-clogging gas drier used extensively. It employs calcium chloride, a charge of this substance usually lasting for several weeks. The moisture condensed in the line drains into a *U*-seal and the gas flows upwardly through the drier, the calcium chloride dissolving gradually and dripping into the seal pot in the form of brine. It is advisable to keep the brine and acidulous condensate separate, as in this figure. In locating the drier it should be kept in mind that calcium chloride is less effective as a drying agent if very hot.

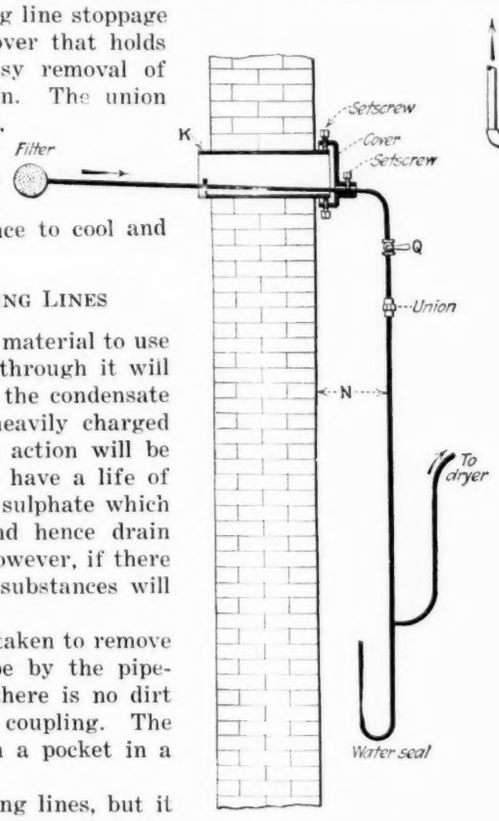


Fig. 3 — A gas sampling line properly installed at the boiler

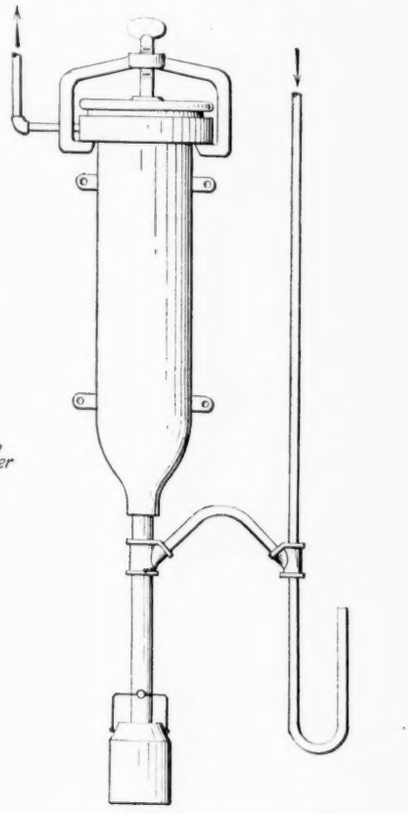


Fig. 4—One form of gas drier. Dry gas is non-corrosive

Many older-type CO_2 recorders employ a water-jacketed condenser instead of a drier, for separating water from the gas, but too often the water pipe ran through a hot location before reaching the condenser, with the result that hot instead of cold water circulated around the sampling line, actually retarding condensation instead of accelerating it.

Sulphuric acid fog is present in flue gas in small proportions, from the burning of sulphur in the fuel. At least one manufacturer considers this fog sufficiently objectionable to warrant the use of a special device to eliminate it. This desulphurizer, combined

with a drier and porous filter, leaves the gas in such perfectly clean condition that it will not discolor or rot a piece of cotton or white paper in the least even though the gas flows through it continuously for six months. Needless to say a gas line and recorder that remain clean and free from corrosion will require very little attention.

For long sampling lines, copper tubing is often used, reducing the possibility of leakage. Where copper tubing is employed, the kind known as annealed seamless-drawn copper tubing is to be recommended, as it does not readily split open or crack in handling. Some trouble has been experienced from tubing splitting when unsuitable grades are bought. Some dealers stock only short lengths of this tubing, but soldering or brazing short lengths together is expensive and gives a less satisfactory job than when long lengths are used.

Care should be taken not to have any line in actual contact with any other pipes, chains, rods, etc., that may be subject to motion or constant vibration, as the continual rubbing is likely to cut a hole through the line in time.

If a steam or compressed-air aspirator is employed, care must be taken not to connect its exhaust with the exhaust from other equipment, as this may subject the aspirator to back pressure, preventing its proper functioning. A separator should be inserted in the steam or air supply line close to the aspirator.

Sometimes the mistake is made of locating the main instrument or accessories inaccessibly, perhaps requiring a ladder to reach them. If this equipment is placed in an intolerably hot location, the attendant is discouraged from the start from taking a proper interest in it.

Careful planning will often result in saving piping, fittings and labor as well as making the equipment easier to operate. Care should be taken in leveling the instruments and setting them plumb.

Overhauling Oil-Engine Pistons

By James M. Bloomfield

After being withdrawn and dismantled, the piston of an oil engine and rings should be thoroughly scoured and all holes cleaned and syringed out with kerosene. The ring grooves should be cleaned of carbon and closely inspected for ridges formed at the back of the grooves by the movement of slack rings. These ridges should be carefully filed down, especially if new rings are to be fitted, for when the piston is again in the liner, the rings are likely to be forced onto the ridges too tightly or, not being able to go far enough into the groove, the rings may increase the liner wear.

It is advisable, if the cylinder or liners are old, to caliper the bore carefully, more especially if the inside walls of the liners show perpendicular streaks, as these are the first symptoms of slight and, if not attended to, dangerous piston seizures.

The piston should also be examined for slight seizures and score marks; these are best taken care of if smoothed down by means of a coarse carborundum stone and finished with a fine grade of hone, taking care to clean off thoroughly any abrasive matter.

The wristpin should be micrometered for wear and the clearance tested, allowing not more than 0.002 in. for each 1½-in. diameter of pin. If possible, the pin should be turned completely around in the bearing, for if the pin is slightly oval it may not have sufficient clearance when moved beyond its working position. With an oval pin turned so that the unworn sides are on the bearing surface, a clearance of 0.001 or 0.002 in. will insure sufficient clearance throughout the arc of movement.

A better method for adjusting wristpin bearings, although somewhat more tedious, is to place the connecting rod in the piston. Next, with the piston standing on end and the connecting rod uppermost, if the rod will just fall by its own weight to either side of dead center, the clearance in the pin bearing is satisfactory. To prevent distortion of the piston due to expansion of the wristpin when the latter has a shoulder at one end and is held by a setscrew at the other, the pin should be driven back from the shoulder about $\frac{1}{32}$ in.

Generally, the first thing to do after the crankcase doors are removed and the oil wiped up, is to take a bar and jump the crankpin bearings longitudinally along the pin. If it moves freely and seems to rise as it strikes the fillets, one is safe in assuming that the bearing is slack. On the other hand, if level on the pin and no rocking felt when each half is put on separately, the bearing halves should not be rescraped, as the hard surface formed on the white metal gives a long life, and this condition indicates good lubrication and correct clearance. If the bearing does not sit level on the pin or if rocking is felt, the bearing should be rebedded. If a part of the white metal is loose, which is shown by oil oozing out, the bearing should be replaced with a new one.

English an Engineering Essential

A few years ago technical schools paid little or no attention to the study of the English language, on the plea that the students should be well grounded in this subject before attempting to learn technics. That plea certainly is specious, for how little the sub-freshman knows about his mother tongue! During the last four decades the speaker, both orally and in writing, has been urging the engineering faculties of this country to give thorough training in that subject and to carry it throughout the entire course of instruction. For a long time no attention was paid to his admonitions or to those of other engineers who were pleading the same cause; but of late the schools have been unable to withstand the reiterated pressure that has been brought to bear upon them, and now most of the engineering curricula include more-or-less-thorough instruction in English.

But even today the ignorance of the recent technical graduate concerning his own language is deplorable! He cannot compose a respectable letter, and his spelling is often atrocious! The reason for this regrettable state of affairs is that the professors are not cognizant of a fact that is recognized by engineers who are concerned with important enterprises, namely, an American engineer's greatest asset is his ability to write and speak English correctly, elegantly and vigorously. He can employ mathematical sharps to make his calculations, foreigners to translate letters written in foreign languages and to reply to them therein, specialists to help with advice and to make his plans; but he cannot hire anyone to talk for him to capitalists and other men of importance or even to prepare his reports, although it is true that he might obtain a certain amount of assistance by having an expert writer polish his literary productions.—*J. A. L. Waddell in May issue of Professional Engineer.*

Choosing and Testing Firebrick

By HUGH E. WEIGHTMAN
Consulting Fuel Engineer, Chicago, Illinois

INSPECTION and tests reject inferior brick. An intelligent study of how brick are made helps the user to choose wisely to meet his needs. This second article* completes the author's discussion of this important subject.

WHILE simple, the practice in some plants of putting sample brick on the bridge wall for test must be used with caution. In the first place the bridge wall is placed at a point where the area of the furnace often is suddenly increased, causing the ash to drop out on the bridge. This beds the brick in ash that may either act as a protective coating or combine as a flux, depending upon the load on the boiler.

As the load grows the thickness of the flame traveling on the arch roof increases. The depth of the flame can usually be told by an examination of the walls under the arch, as the flame leaves an inverted high-water mark as plain as any stream ever did on its bank. If this flame becomes thick enough to lick the brick samples, the fluxing action begins. The higher the temperature the faster the action. If the flame does not lick the bridge, the brick will be protected. The fact that the brick are totally immersed in heat without a chance to dissipate it, means that the samples will be at furnace temperature all the way through. This is harder service than having one end exposed to the flame and the other open to the air.

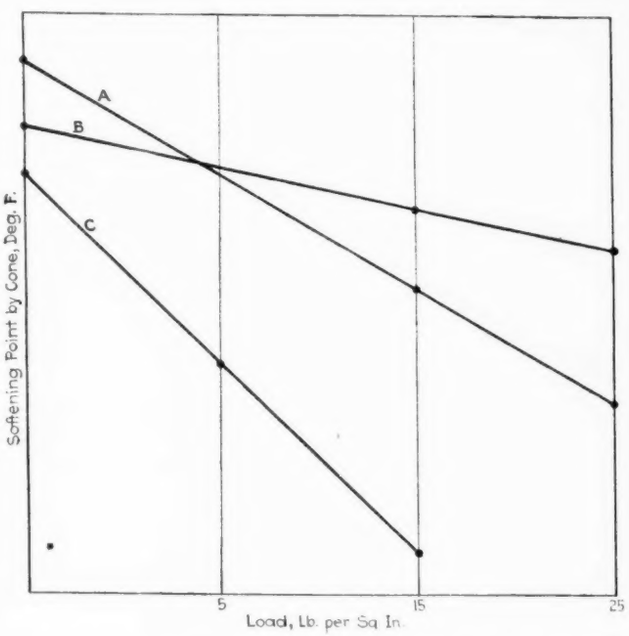
Placing a test brick halfway into the wall is often a better test, although here the location means a great deal, since if the different samples are to be given the same treatment, all must be fired at the same time, and to insure equal temperatures all the brick must be located in the same horizontal plane. As a rough test this is better than placing them on the bridge wall. It is the only resort where a bridge wall extends to the tubes. In placing the brick, remove a header brick, place the sample one-half or two-thirds into the hole thus created and seal up the cracks with fireclay.

Texture and Firing

In certain specifications the attempt has been made to set a limit on contraction and expansion. The specifications have ordered firing at temperatures in excess of 2,500 deg. F. for five hours, with the idea that overfiring of the refractories would determine the relative quality. In general such a test has been abandoned, since overfiring is not the sole cause of expansion, and some brick would be rejected as expanding unduly, which were capable of giving excellent service. The test may be used to advantage in detecting bricks that have been underburned in manufacture, since such bricks have not been shrunk to a permanent value and excessive contraction would disqualify them.

Brick high in iron and low in lime and alumina, when underburned, usually can be picked out by the white appearance and the soft texture. However, where the alumina is sufficiently high or if there is considerable lime, the brick may be hard burned and completely shrunk and still have the white and soft texture. The fact that the firing temperature of the refractory is well above mean wall temperature, makes the contraction and expansion feature relatively unimportant.

A much better and simpler test for the determination of proper texture and firing of a refractory is that of examination under a low-power microscope after firing for about ten hours at the maximum furnace temperature expected. The firing rate and the cooling should simulate furnace conditions. If the sample now be broken and the edge examined, the character of the brick will be shown.



Softening or melting point lowers with increase of load

If a nearly transparent glassy formation obtains on the exterior and extends into the refractory more than 0.1 in., the brick has a tendency to combine with fly ash in service under coal firing. The result will be rapid fluxing and a tendency for the surface to shatter or craze in small particles. Up to 0.1 in. the formation in this period of time does little harm. Some highly silicious brick have this formation of glass to as much as $\frac{1}{2}$ or $\frac{3}{4}$ in. deep. The more transparent the particles the poorer the specimen. The sample should be fired to at least 2,200 deg. F. and, if the furnace temperature for which the brick are being selected is higher, to the furnace temperature, but no higher. The extension of the glassy portion to $\frac{1}{2}$ in. or more shows a brick that will spall badly in large pieces.

While slag action is important in metallurgical fur-

*The first article, "What Is Good Firebrick?" appeared in *Power* for Oct. 5, 1926, page 508.

naces, it is not of importance in the case of boiler furnaces. What is often taken for the result of slag formation on boiler-furnace brickwork is the result of actually melting the brick at the face, owing to too heavy loads on the face of the refractory. The accompanying curves show the reason for this melting. In any brick with a given softening point under no load, as determined by the usual test, it will be found that as the brick is loaded the face starts to soften at a lower and lower temperature as the load is increased. Some brick soften more readily than others, as the curves of three different samples show. It is assumed commonly that the softening point temperature found on test holds in service, and knowing that the furnace temperature is far below this, it is assumed that the flow has been due to slag action. Usually, the ash from the fuel is quite silicious and likewise quite refractory and rarely combines with the firebrick unless the firebrick has a considerable portion of unsatisfied alumina. Much of the alkalies in the fuel are far above the volatile point where they leave the fuel and go out as gas rather than as solids or liquids. Gaseous elements have little effect on refractories. Chlorine, sulphur and iron merely act as hardeners to the surface, rendering the body viscous, if soft, and thus protecting it. It is probable that other elements like carbon have a similar action.

Special Furnace with Observation Door

For testing refractories it is considered of practical value to equip a furnace with a protected observation door, using a non-actinic glass of sufficient thickness for protection but thin enough for clear observation. Use a furnace of the same type as recommended for the deformation-under-load test. Under each load determine the temperature required just to start the softening and running of the refractory. This can be seen through the observation port. Plotting the results as in the accompanying illustration gives at a glance the value of a given brick for any temperature and load condition, except as to spalling. A test of this kind, together with tests on spalling, are really all that need be done to insure suitable refractories for any boiler furnace service.

Visual Inspection

In addition to the tests under heat, it is desirable to subject each car of brick to a visual inspection. Such inspection should be complete and not limited to a few samples. The inspection program should cover dimensions, texture and hardness of burn.

Except for repair work the maintenance of like dimensions are not important so long as the whole lot of brick check up to some given dimension within reason. The ratio of the width to length, however, should be such that, when laying header and stretcher courses, the joints will break without the necessity for adding soaps to the header course now and then to insure breaking joints. This difficulty has been found with a number of firebrick on the market, but such cases are gradually becoming less. The trouble usually develops from changes made in the clay combinations at the plant without changing the equipment. The change in burning shrinkage alters the ratio of width to length. Usually, where this is encountered, it is necessary to add a soap to the header course every ten or twelve brick. This construction is not a bad fault if the furnace were permanent, but causes a different problem when an attempt is made to patch a wall and do a workmanlike job that will be stable.

Many of the more progressive brick plants have adopted additional supervision and have taken to gaging the brick, so that now it is a simple matter to hold to uniform sizes. The thickness is not important as to absolute dimension so long as all the brick have the same dimensions. If great irregularity exists, it is necessary to use thick joints, and these result in shrinkage cracks and unstable walls if the amount of unburned clay in the wall is greatly increased.

Texture Varies with Process of Manufacture

The texture of the brick will vary with the kind of fuel used, the firing apparatus, the character of the clay and the process of manufacture. Brick used in boiler furnaces are commonly made by the dry-pressed, hand-made or stiff-mud processes. Clays used are either open burning or close burning, referring to the manner in which the clay particles cohere. In the open-burning clays the particles shrink together but leave many voids. In close-burning clays a matrix forms around the particles, leaving little void space. The matrix may be glassy or stony, depending upon the kind of clay, the stony matrix being preferable. By adding grog or calcined clay, a brick is rendered more open burning. Where close-burning clay is encountered, such as that typical of the Missouri district, raw flint as well as calcined clay and flint are added. The raw flint assists in making the brick more open burning without reducing the binding power of the plastic clay to too low a value. A brick of this composition is well suited for boiler-furnace service owing to its all around good qualities. It is, however, a difficult brick to make.

Dry-pressed brick of either kind of clay run close to dimensions. The dry-pressed brick of close-burning clay is better than the open-burning clay brick for hand-fired furnaces and in stokers where the fuel bed is allowed contact with the side walls. Also it is better brick for bridge walls, especially at the dump plate.

Large pieces and complicated shapes are of course hand made. Here a larger amount of bond clay is necessary than with dry-pressed brick. On this account it is necessary to use larger grog size to insure open enough texture to allow safe drying. Hand-made brick were once greatly preferred to stiff-mud brick, as the latter process usually produced laminations on account of the manner in which the auger fed the clay through the machine. Aside from large pieces there is no advantage in hand-made brick except for the manufacture of small roof tile, bungs and other metallurgical furnace work. For boiler furnaces the dry-pressed and stiff-mud brick offer the best solution of the refractory problem.

In the stiff-mud process the clay is worked to a plastic state and augered through a die, after which the brick are cut off and re-pressed. The stiff-mud brick made with an auger of proper pitch produces a brick of dense structure and without laminations. There are still a few plants left where the equipment is not suitable, and as a consequence laminations still show in the brick. Heavily grogged clays to produce open-burning texture are hard on dies used in the stiff-mud process, and for that reason considerable variation in width and thickness of the brick will occur from time to time unless the manufacturer is alert. With a given clay the stiff-mud process produces a more dense brick than the dry-press process.

For heavy wall loads it is desirable to use stiff-mud brick or good hand-made brick. For light wall loads the dry-pressed brick is better, being more refractory, easier to handle and closer to dimensions. Where high walls are to be installed, it is a desirable feature to install wall tie blocks for the purpose of carrying the load back to the cooler portions of the wall, so that the hot face of the wall is not depended upon to carry the load. Under such conditions the load-bearing capacity of the brick under high temperature need not be considered, with the result that longer life may be had and greater freedom from shutdown. This is specially important in powdered-coal operation. The low load-carrying capacity of highly refractory clay led to the development of water-cooled furnaces. The face of the wall tie blocks should not exceed the thickness of two bricks, as the troubles commonly experienced with large blocks would develop.

Relieving arches to take the load from the upper structure should be built of load-bearing refractories and the arch placed at such a point that it will not be subjected to high temperature. This is often impossible to do, and several arches are built in the side wall. The disadvantage of the relieving arch is the difficulty of installation, uncertainty of the masonry work when completed and the impossibility of tying into the brickwork deep enough for stability. A further disadvantage is that it throws the load to the corners where refractoriness is necessary. A great deal of time and trouble has been spent in trying to produce a highly refractory brick of load-bearing quality, an improbable feat if at all possible.

Size and Hardness of Burn

For boiler furnace service with oil or powdered-coal firing, the mechanical texture of the brick should be as fine as possible without causing drying difficulties and the consequent hair cracks that cause failure. As the pieces become larger or more complicated, the grain texture should be increased to insure drying without great stress. Most of the trouble begins before the tile are burned. Many cracks are present in tile that appear perfect, being visible only under low power magnification. Smaller and simpler tile for arches are preferable, as then the texture may be fine and more uniform.

Where tile of considerable size are heated from two sides, spalling is bound to occur, and if the tile are sufficiently large or greatly exposed, large pieces usually drop off every time the furnace is started up. No specification nor test will help here. It is a case of faulty design that must be corrected, for the manufacturer cannot make a tile that will stand such abuse.

The hardness of burn has a great deal to do with the way in which a furnace lasts. For slow firing and moderate or low temperatures, a real hard-burned brick will last, but it will be difficult to cut and lay. Hard-burned brick usually are over-burned and often small in size. Such brick should never be allowed in powdered-coal or oil-fired furnaces, nor in furnaces used to swing the load, as short life from spalling and slabbing will be the result. An under-burned brick is even more dangerous, since its shrinkage in service is likely to break off header courses and allow the upper wall to lean. This is specially true for overhanging parts.

Under-burned brick had best be rejected; hard-burned brick, if not suited to the furnace interior, may be used in the center of the wall where temperatures are low and changes not rapid. These off-burned brick are due to differences in kiln temperatures. The average plant uses the under-burned brick for grog and the hard-burned brick, to about 3 to 5 per cent of the total, are usually shipped with each car. Where hard-burned brick cannot be used, the purchase order should specify this fact, but where they are suitable, as in some hand-fired jobs, the manufacturer should be so advised so that he may have a chance to dispose of this brick. If these features are watched, better service will result.

Where large quantities of brick are used, it is desirable for the staff to know each of the plants from which the brick may be shipped. Engineers designing furnaces should be acquainted with the product of one or more manufacturers, so that they may take advantage of their plant equipment. A careful tabulation of the desirable features for brick or tile to be used on a job and a discussion of these features with the refractory manufacturer will add to the life of a furnace that otherwise might have been a failure.

To secure the best firebrick for your job: Be sure the limitations in the specifications are right; avoid meaningless specifications that cannot be checked; do not specify such rigid limits to one feature as to render other desirable features impossible; use every means possible to relieve refractories of load-bearing functions when high refractoriness is required; tell the manufacturer explicitly what is required; avoid large tile heated from two sides; inspect the shipment or know that the manufacturer will do it for you in a proper manner.

Corroded Draft Tube Causes Loss of Power

By M. B. Thurston

A hydraulic turbine that had been giving satisfactory service for about twelve years was shut down for its annual inspection. During the last month in service the operator had noticed the power gradually dropping, and in the last week it had suddenly gone down about 10 per cent.

It was at first thought that a new runner would be needed, perhaps new gates and other small wearing parts. After the turbine was opened up, the runners were found to show hardly noticeable wear, and beyond a new set of gate links things were in good shape. But why the loss of power, now amounting to nearly 25 per cent of the total capacity, when all parts seemed in good order?

Examination of the draft tube showed that its upper third had several irregular holes eaten through the metal, which did not appear to have been more than $\frac{5}{16}$ in. thick originally. It was noticed that the height from the holes to running tailwater was about 8 ft. As the total head was 34 ft., if the lower 8 ft. was lost by the air leakage, a power loss of nearly 25 per cent is easily accounted for. A new draft tube was installed, which restored the turbine to its normal power. To protect the metal in the draft tube from the corrosive action of the water, it was given several heavy coats of asphaltum paint.

In Spite of the Variation in the heating value and other characteristics of fuels, the theoretical weight of dry air required for combustion is very closely 7.5 lb. per 10,000 B.t.u.

*Boiler Feed-Water Purification—XV**

Feed Heaters and Miscellaneous Treatment

This Article Shows How Heaters, Oil Filters and Strainers Play an Important Part in Feed Treatment and Presents the Arguments for and Against Electrolytic Treatment

By SHEPPARD T. POWELL
Consulting Chemical Engineer, Baltimore, Md.

THE primary purpose of feed-water treatment appliances should be the prevention of scale formation, the reduction in priming and foaming and the elimination of corrosion. To accomplish these results is frequently a difficult and costly procedure. It so happens, however, that most waters contain solids that are easily removed so that relatively simple methods of treatment, if properly chosen and intelligently operated, may effect marked improvement in the quality of the supply. Properly designed subsidence tanks, heaters and simple forms of filters and grease extractors are of great value. These relatively simple purification methods, used in conjunction with intelligent blowing down of boilers, are frequently much more effective than many of the mysterious and secret systems now offered for feed-water treatment.

Heaters—Closed and Open Types

The primary purpose of feed-water heating is to effect economies in the operation of boilers. However, with certain types of heaters, an appreciable amount of purification may take place also. The advantages to be gained by heating of the water prior to discharge in the boiler may be summarized briefly as follows: (1) Less fuel consumed for steam generation; (2) reduction in strain in tubes and shells; (3) increased steaming capacity of the boiler; (4) partial removal of mineral solids and non-condensable gases in some types of heaters.

Feed-water heaters may be classified into three types—closed heaters, open heaters and economizers. Closed heaters consist of a bundle or nest of coils inclosed in a metal container or shell. Some closed heaters take the steam on the inside of the tubes and some on the outside.

Closed heaters are not well adapted to heating water containing suspended solids or salts that deposit when the water is heated. Heaters of this type are frequently difficult to clean. Where scale forms on the tubes, the efficiency falls off rapidly because of these deposits. Oil should be removed from the steam prior to discharging into closed heaters, since oil also is a poor conductor of heat. Various types of closed heaters have a particular sphere of usefulness as extraction or bleeder heaters, where the feed water is heated by steam bled from steam turbines.

Jet-condenser heaters are coming into use in large steam stations and have a particular sphere of usefulness. These are special types of jet condensers in which the condensate is sprayed into a chamber and heated by the steam coming into direct contact with the water. Apparatus of this kind may be used to advantage to maintain the oxygen content of the condensate at a low concentration.

Open heaters, frequently termed contact heaters, are designed to bring the steam and water into intimate contact. This is done in various ways, by steam jets or by spraying the water into an atmosphere of steam. Various types are built to function in free exhaust, with back pressure, as deaërating heaters and for other conditions.

Feed-water heaters of this kind may remove a substantial portion of the impurities. Much of the scale-forming solids due to bicarbonate will be precipitated in these heaters and under some conditions the sulphate content of the water will be materially reduced also, provided the temperature of the water is raised sufficiently high. Since open heaters are vented, there is an opportunity for the escape of oxygen, carbon dioxide and other gases which are released when the water is heated. All open heaters are based upon the same general principles, but the designs differ materially, depending on the kind of service for which they are to be used.

On the next page is shown an open heater designed to operate with exhaust or other low-pressure steam. The steam is discharged into the space in the upper portion of the shell and the water is sprayed downward through the steam by passing over perforated plates having serrated edges. This is to assist in the intimate mixture of steam and water and also aids in the release of gases which are dissolved in the water. The trays are so placed that successive ones are inclined in opposite directions and the water drops from one tray to the next one below it in the

*Previous installments have covered the following subjects: July 6, "Natural Waters and Their Impurities"; July 13, "Getting Rid of Impurities by Sedimentation and Coagulation"; July 20, "Filtration by Gravity and Pressure Filters"; July 27, "Softening Water by Chemicals"; Aug. 3, "Hot Process Continuous Softeners"; Aug. 10, "Zeolites Explained"; Aug. 17, "Where Zeolites Fit In"; Aug. 24, "Boiler Compounds"; Aug. 31, "Priming and Foaming"; Sept. 7, "Embrittlement—What Causes It"; Sept. 14, "Evaporators, Their Design and Operation"; Sept. 21, "Getting Rid of Dissolved Gases by Deaëration"; Sept. 28, "Corrosion—Its Cause and Cure"; Oct. 5, "Deconcentrators and Continuous Blowdown."

series. These trays may be removed by opening a door in the side of the heater and sliding the trays out on the guides. Some heaters of this type have a small filter in the bottom. This serves to remove suspended solids which have been thrown out of solution by heat.

The economizer is another type of feed-water heater, the source of heat utilized being waste flue gases. The usual design consists of a series of steel or cast-iron pipes, the ends of which are fastened into headers placed vertically or inclined within the flue between the boiler and the chimney. The temperature of the water is raised by the flue gases as it is pumped through the economizer tubes on its way to the boiler. The temperature of the water from economizers as discharged into the boiler will vary anywhere from 250 to 300 deg. or higher. This will depend upon the temperature of the flue gas and entering water. Trouble may result due to corrosion and scale formation if the water reaching the economizer tubes contains an appreciable amount of scale-forming solids or dissolved gases.

Oil Filters and Strainers

Many appliances are sold for the removal of oil or suspended matter from feed water. Some of the devices offered for this service, being nothing more than coarse strainers, are of little value and accomplish little or no purification. But there are on the market several efficiently designed filters and grease extractors which remove most of the suspended solids. The filter medium used extensively for this purpose is Terry cloth or other closely woven material. The cloth is frequently wound around a cylinder or cartridge, the water going through a number of layers in passing through the apparatus. These extractors are built as single or twin-unit types. Where twin filters are employed, one unit is held in reserve and put into service while the other is being cleaned.

These appliances may, in the absence of other forms of feed-water purification, markedly improve the quality of the raw water. Their effectiveness in the removal of grease is generally recognized. They should not be looked upon as complete purification systems, since they do not remove the soluble scale-forming solids. When used for clarification of turbid surface waters or waters containing suspended solids from trade-waste pollution, their use is justified either alone or in connection with more complete methods of treatment.

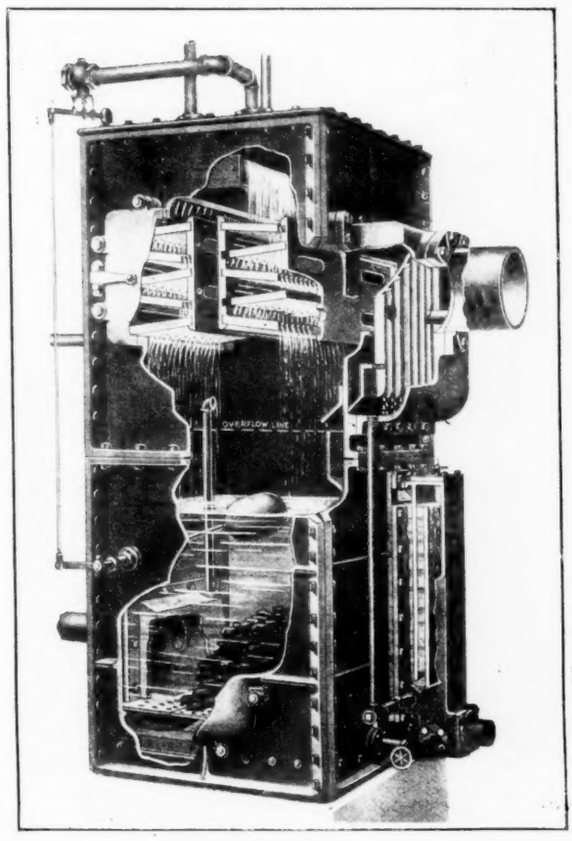
Electrolytic Treatment for Prevention of Scale and Corrosion

During the last fifteen years a number of electrolitic processes have been developed to prevent corrosion of boilers and scale formation. This treatment has been applied with more or less success abroad and recently has been actively exploited in this country.

All electrolytic processes for the prevention of scale and corrosion may be classified into two groups, (a) where the current is supplied from an external source, (b) current generated by a thermopile or thermocouple. The general principle of these processes consists in supplying a direct current of low voltage and amperage to the boiler. This tends to prevent iron ions passing into solution in the water and in some cases reduces or prevents scale formation. Numerous theories have been advanced to account for this action. In discussing the action of the counter-electrical method as applied to protect the tubes of surface condensers, Bengough and Hudson[1] have given a plausible explanation of the phenomenon as follows:

"The usual explanation of electrolytic protection is that no action of any kind, electrochemical or chemical, can take place on the cathode itself, since it is protected by a film of hydrogen in some form or another. . . . It must be concluded that a general statement of this kind cannot be substantiated, nor is it compatible with the observations made on protected tubes in practice. . . .

"It has been found in the laboratory as well as in large-scale experiments that when a piece of metal is made a cathode in the presence of sea-water,[2] it becomes



Typical open feed-water heater

coated with a layer of calcium carbonate soon after immersion. The layer is very thin and does not appear to increase in thickness with time. It is not absolutely impervious to oxygen or salts in solution, for the formation of oxysalts sometimes takes place slowly beneath it. No doubt, however, the rate of formation is greatly reduced. The authors believe that in this layer lies the chief secret of the success of the protection process. . . .

"The layer, in the first place, prevents contact between the sand, etc., and the tube, and by its uniformity of distribution prevents the local accumulation of the products of corrosion on the actual surface of the tube. It also slows down the rate of formation of such products, by reducing the rate of oxidation, and in this

[1] "Jour. of the Institute of Metals," Vol. XXI, No. 1, 1919, pp. 204-205.

[2] Other waters containing calcium carbonate or bicarbonate would act in a similar manner.—The Author.

latter action it is no doubt helped to a limited extent by the tendency to produce hydrogen at the cathode. This last action by itself, however, would not be sufficient to reduce oxidation to the extent that actually occurs, and in the opinion of the authors the formation of the carbonate layer is the important feature of the process."

A fairly large number of electric processes have been developed recently abroad and in this country. The results obtained have been by no means consistent. In some instances, the process used has given satisfactory results and other installations have been complete failures. Many factors influence the results, and it is the control of these conditions which is responsible frequently for the success or failure of the installations. An important item is that the entire cathode surface be reached by the current flow. Uniform distribution is frequently difficult to maintain. The amperage employed per square foot of surface area in one instance with a water of a certain chemical composition may be highly ineffective when the system is used in another boiler where the makeup water is chemically different. Attention has been directed also to the fact[3] that if current used is too high, the corrosion of the anodes may be excessive and as a result the increase in oxygen generated may accelerate corrosion of the metal outside the protected zone. "It is, therefore, unsafe to rely too much on electrolytic protection without taking other precautions."

The author has within the last two years investigated a number of installations of this kind. Some of these appeared to be fairly efficient in reducing scale formation and preventing corrosion. In other cases no apparent improvement could be noted, and in one instance corrosion of the tube and drum of the boiler was undoubtedly accelerated.

In a serial article in *Die Wärme*, by Herman Marrz (July 11, 1924), the following statement appeared. "There is still a good deal of doubt as to how far electrochemical processes are capable of displacing mechanical, chemical or thermal processes, and, in particular, some of the leading German concerns engaged in water purification have expressed either doubts or lack of conviction as to electrolytic processes."

Under proper control and when designed efficiently to meet a particular set of conditions, there is sufficient evidence to indicate that certain electrolytic processes for scale prevention and inhibition of corrosion have merit. When not carefully controlled, the system may actually do damage to the boiler.

[3] F. N. Speller, "Corrosion, Cause and Prevention." McGraw-Hill Book Co., Inc., 1926, page 437.

Smoothing Out the Load with a Steam Accumulator

By A. A. POTTER and M. J. ZUCROW*

CONSTANT boiler load with variable steam demand extends boiler capacity, improves efficiency and opens a way to the use of inferior fuels.

IN ANY steam generating plant whether it is an industrial plant which uses steam for process work, heating or power production, or whether it is a plant in connection with an electric public utility, the demand for steam that the load imposes upon the boilers varies from time to time. Thus, if the steam demand is plotted against the time of day, curves similar to those shown in Fig. 1 are the result. The amplitude of the fluctuations or variations from the average steam demand will depend upon the character of the load.

The purpose of the accumulator is to enable boilers to be fired at a constant rate, the fluctuations in steam demand being met by the accumulator. This enables mechanical firing to be utilized to its fullest advantage. This not only reduces the cost of attendants, but also enables operation to be controlled to produce the best conditions for combustion. In addition to the savings wrought by decreased attendance and better combustion of the fuel, there is a reduction in boiler maintenance due to the uniform rate of fuel consumption, the temperature of the furnace walls and boiler surface being substantially constant and strains due to intermittent periods of expansion and contraction being thus precluded.

Steam accumulation is not a new process, but the accumulators in the past have been mainly exhaust steam or boiler-feed water accumulators, and they did not meet with any great success. It was not until Dr. Johannes Ruths, of Stockholm, Sweden, perfected his system of steam accumulation that general use was made of the principle.

The performance of this accumulator, which was described in detail in *Power*, Aug. 28, 1923, is based on the principle of storing heat energy in a body of hot water in a closed container. When the pressure and consequently the temperature of the hot water are decreased, steam formed by re-evaporation from the water is discharged. Thus the variation in the heat content of water with temperature is utilized for heat accumulation purposes. The storage capacity of water at different pressures is shown by Fig. 2, which enables one to determine quickly the pounds of steam discharged per cubic foot of storage capacity for any pressure drop. Fig. 3, plotted for a similar purpose, shows the amount of steam produced from 1,000 cu.ft. of boiling water by a pressure drop of 10 lb. per sq.in., with different initial steam pressures. This figure illustrates the greater accumulation capacity of hot water under low pressures.

Although accumulators are generally built with a capacity from 10,000 to 40,000 lb. of steam per hour, tanks with a capacity of 80,000 lb. have been built. In some cases small accumulators are also used as, for

*Members of the engineering staff, Purdue University, Lafayette, Indiana. The authors wish to acknowledge their indebtedness to Alfred J. T. Taylor, of Toronto, Canada, for furnishing them with data on the Ruths accumulator.

example, one of only 180 cu.ft. capacity which has been installed in Stockholm. In addition to the usual services for which the accumulator is adapted, its use has been recently suggested in several new capacities.

The distinction between recent accumulator developments and earlier practice is in the development of direct boiler applications. Formerly, the accumulator was used to receive the intermittent exhaust of an engine and deliver a steady flow to an exhaust steam turbine, or the

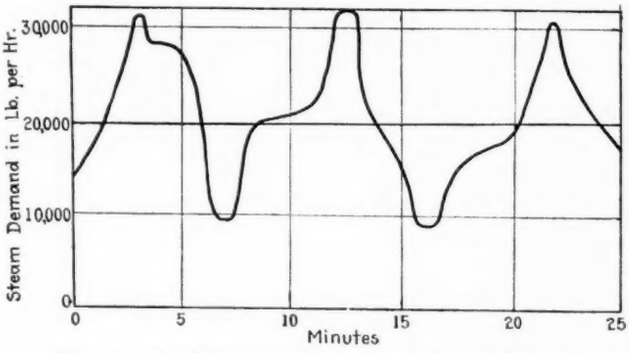


Fig. 1—Variation in the rate of steam demand in a factory

like. Now it is proposed to connect the accumulator to the boiler system. When the steam demand is low, the boiler pressure rises and the accumulator absorbs the excess steam. When the demand increases, the operator allows the pressure to drop, and the accumulator yields steam and so lightens the boiler load.

High-Pressure Steam Boilers Will Have Reduced Inherent Accumulation Capacity

From Fig. 2 it can be seen that if a boiler has its pressure lowered from 400 lb. per sq.in. to 350 lb. per sq.in. gage, a cubic foot of water in the drum can re-evaporate only 0.8 lb. of steam. On the other hand, if there is a demand for low-pressure steam in the plant and this same pressure drop of 50 lb. per sq.in. can take place in a Ruths accumulator operating with a pressure range of 60 to 10 lb. per sq.in. gage, the quality of steam re-evaporated by a cubic foot of water will be over five times as large; that is, 4.2 lb. In other words, the storage capacity of the boiler per cubic foot is less than one-fifth of that possible in a Ruths' accumulator designed to operate at the lower pressure range. Furthermore, a 50-lb. fluctuation in boiler pressure is usually inadmissible and a smaller fluctuation will reduce still further the accumulation capacity of the boiler.

This accumulation capacity depends upon the cubical contents of the boiler also, and, as Dr. F. Munsinger[1] points out, this is an especially important factor in the case of high-pressure boilers. These boilers are very expensive, the greater part of the capital investment being absorbed by the cost of the drums, which have to be made of small diameter or the cost is prohibitive. Hence, the water space provided in these steam generators is very limited. This deficiency cannot be adequately met by flexibility in the firing apparatus, and in the case of very high pressures some form of steam accumulation should be provided.

The Ruths' accumulator is adaptable to cases where the heat supply for generating the steam is varied from time to time, for example, in plants using blast-furnace gas. In these cases the rate of steam generation fluctuates with the supply of fuel. This condition necessitates the use of boilers with ample capacity to utilize all the heat that can be obtained from the largest supply of fuel that may be delivered to it. Thus a boiler size is larger than that necessary to burn the average fuel supply. In such situations the Ruths system can be installed to accumulate the steam generated by the gases and to discharge the steam to the point of consumption at the proper moment.

In the case of producer-gas plants the gas producers should furnish the supply of gaseous fuel at a constant rate. The boiler demand is fluctuating. Hence with an accumulator, the gas may be burned beneath the boiler at a constant rate and the load fluctuations can be met by the steam accumulator in the ordinary manner.

Wherever waste heat is being used for steam production, the accumulator finds a fertile field. It makes possible the continuous operation of the gas engine at the most efficient load. At this load the large gas engine supplies a constant quantity of waste heat for the boilers, and with the accumulator, low-pressure turbines can take care of load fluctuations. Thus it is seen that

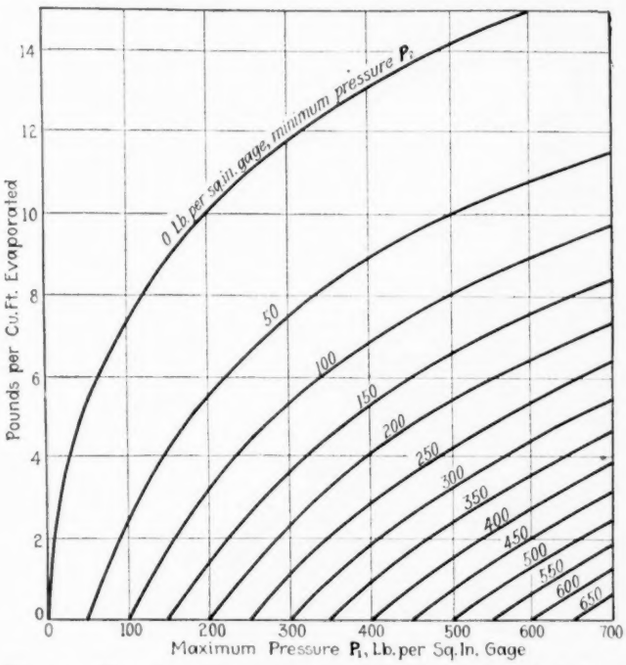


Fig. 2—Showing the amount of steam evaporated from 1 cu.ft. of water at its saturation temperature when its pressure is decreased from p_1 to p_2

the accumulator makes it possible to utilize waste heat efficiently regardless of variations in the rate of steam consumption.

Inferior Fuels Can Be Advantageously Burned at a Constant Rate

Prof. E. Josse, of Berlin, Germany, in his "Report on Ruths' Steam Accumulator," says: "Nowadays it is often necessary to use inferior fuels, such as coal dust, coke breeze, brown coal, wood chippings, etc. In such cases the normal steam output can only be approximated when specially constructed furnaces and forced drafts are adopted. To force the boiler plant becomes quite impossible. Many difficulties are encountered if the

[1] "High Pressure Boilers"—Transactions of World's Power Conference, Vol. II.

draft is insufficient, especially if the fuel contains a considerable amount of incombustible material. In all such cases the use of the accumulator facilitates the use of such a fuel. It becomes unnecessary to force the boilers, and the boiler load may be adjusted and kept in accordance with the possibilities of the boilers under such conditions."

Accumulator for Superheated Steam

The steam delivered by the accumulator described, can, of course, be dry saturated only. This is the result whether superheated or dry saturated steam is used for

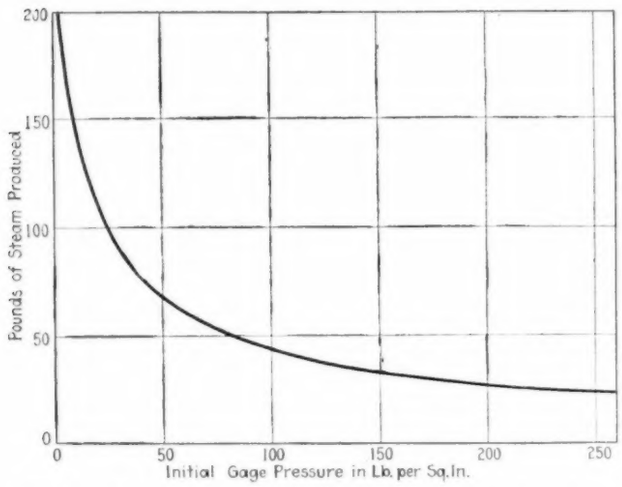


Fig. 3—Showing the amount of steam produced per 100 cu.ft. of water at its saturation temperature by a drop in pressure of 10 lb. per sq.in.

charging the apparatus. However, it is often desirable to store superheated steam, and Doctor Ruths solves this problem by adding to the ordinary accumulator a second tank containing cast-iron plates and designed so that it utilizes the well-known principle of the regenerative heater used in metallurgical furnaces for preheating the gases and air for combustion. These superheated steam accumulators thus consist of two separate containers, one for storing the latent heat of the steam and the other for storing the superheat.

Use of Accumulator in Power Plant

In ordinary power plant operation the accumulator may be connected between the high- and low-pressure stages of the turbo-generator. This does not introduce any decrease in the available heat drop for the following reasons: The steam pressure and the superheat are automatically maintained at their maximum valves, the efficiency of the high-pressure stage is practically constant, irrespective of the pressure fluctuations in the accumulator, and by installing an automatic expanding nozzle in the low-pressure stages the heat can be used there without any loss. There is introduced an extra back pressure, however, which is due to the head of water above the nozzles in the accumulator, but this is so small that it has no practical importance.

Some Savings Obtained with Ruths' Accumulators

Prof. E. Josse, in his report, gives the following savings in percentage of fuel for different uses of accumulators: At sugar refinery, Gothenburg, 15 per cent; at wood pulp and paper mill, Grycksbo, 14.5 per cent; at wood pulp and paper mill, Slottsbron, 15 per cent; at A. B. Stockholms Bennjolsfabrik, 16 per cent. These savings are the result of a steady load on the boiler and the improved combustion conditions. Professor Josse also states that the foregoing gains are supplemented by possible reductions in boiler-heating surface, attendance and maintenance.

In plants using steam for process work the accumulator brings even greater benefits. The increased proportion of time during which steam is available results in increased production with consequently larger profits. For example, in the case of a pulp mill the steaming time was reduced from between 1 and 2 hours to between 15 and 20 minutes, the time for the heating process was reduced from between 4 and 4½ hours to between 2 and 2½ hours.

These brief notes will suffice to point out a few of the possibilities and to indicate that in any case where the steam demand or the supply of hot gas or fuel is variable, a steam accumulator may save money through its extension of the boiler capacity and through the better efficiency attainable with steadier rates of steaming. The accumulator is worth studying.

Big Relief Valve for Hudson Avenue

The Edward 45-in. atmospheric relief valve shown herewith weighs 23,000 lb. and has an over-all height of 17 ft. 5 in. It will soon be installed in the Hudson Avenue generating station of the Brooklyn Edison Company

Valve weighs 23,000 lb. and is 17 ft. 5 in. high

to protect the new 80,000-kw. turbine against failure of the vacuum. An 80,000-sq.ft. condenser is attached to the unit.

Protecting Motor Drives in Pulverized-Fuel Plants*

Selecting Proper Protection for Motors and Controllers, an Electrical Interlocking System to Insure Correct Functioning of the Equipment and a Reliable Power Supply Are Three Essentials to Satisfactory Operation

By M. B. WYMAN
General Engineer, Westinghouse Electric and Manufacturing Company

IN SELECTING motor protection, primarily it is desired to protect the motor against injury to the windings which may be caused by internal faults, overloads sustained for a sufficient length of time to cause excessive temperature, reverse or open-phase and low-voltage conditions. In the case of squirrel-cage induction motors for full-voltage starting, overload protection cannot be used since the time setting on such over-current relays will have to be very high during starting so that adequate protection for sustained overloads is not provided. In such cases thermal relays may be applied.

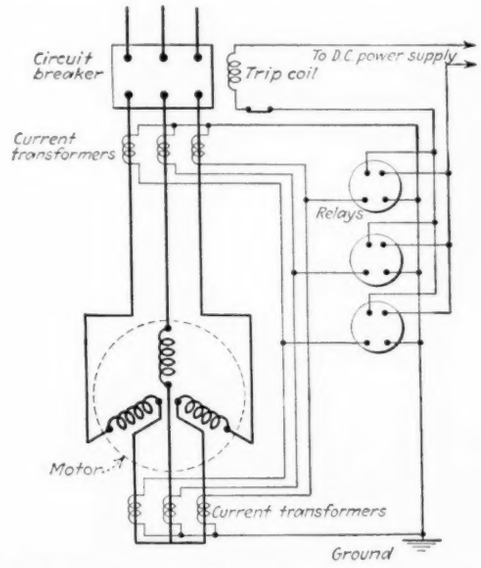


Fig. 1—Connections for differential-relay protection of star-connected induction motors

To protect against internal faults differential protection may be provided, for which purpose six leads must be brought out of the motor. Diagrams of these connections are shown in Figs. 1 to 3. Such internal faults may be roughly classified as phase-to-phase short-circuits, short-circuited turns, open-circuits and grounds.

If six leads cannot be brought out for differential protection, protection against internal faults may be obtained by application of the newly developed phase-balance relay. This relay has been developed mainly for protection against operation of a motor single phase, but it provides protection for all faults except three-phase shorts which are otherwise provided for. It will be noted that only two current transformers are used in two wires on a three-phase circuit. They are connected to an impedance network so designed that no current flows through the relay as long as the three-phase current is balanced and the phase rotation correct. A schematic diagram of the relay's connections is shown in Fig. 4.

Under-voltage conditions at a power plant are considered in an entirely different aspect from those at some customer's location. In the event of a short-circuit outside the station the voltage will take a momentary dip, but will return to normal in a few seconds as soon as the fault is cleared. During such times, the pulverized-fuel equipment in the power station should not be dropped out. The current drawn by the motors during these low-voltage conditions is several times normal, but is not objectionable, as it might be outside the power house. Therefore, low-voltage protection should be omitted on all full-voltage-starting type motors, since by so doing they are made automatic restarting by merely leaving in the line switch or contactor on complete voltage failures. This is one point in favor of full-voltage starting of motors for continuous operation.

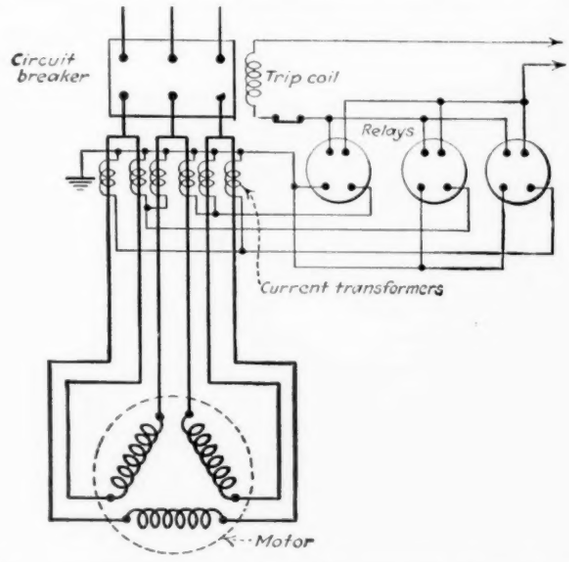


Fig. 2—Connections, using six current transformers, for differential-relay protection of delta-connected motors

In the case of motors for low-voltage starting,

*An article, "Making Electric Drives Safe in Pulverized Coal Plants," appeared in the Oct. 5 issue.

low-voltage protection must be provided, but such applications usually belong to that class of drives for intermittent service and with operators in attendance, hence automatic restarting is not so essential.

In the case of wound-rotor induction motors, they are not necessarily automatic restarting if left on the line during a voltage failure. At standstill and with the rings short-circuited these motors have low torque points and the return of full voltage may not start the load and would then cause overheating of the motor windings. Hence, provision must be made for automatically inserting in the secondary circuit a block of resistance sufficient to produce the required torque to start the load. A simple method of doing this is to apply a contactor to the secondary circuit, the holding coil of which may be energized from the line, so that on under-voltage conditions the contactor will drop out and insert the resistance. Reclosure of the contactor may be accomplished by a current-limit relay.

In the case of direct-current motors applied to the fuel-feeder drives, overload protection is essential owing to the possibility of the fuel clogging. Fuses and thermal relays are used in some installations for overload protection. Provision should also be made, so that on failure of voltage the controller will be returned to the "start" position.

Electrical Interlocking

Tracing the coal-flow path through a pulverized-fuel plant from the time the raw coal is received to the stage where the fuel is stored in bins or fired into the furnace, it is evident that the flow must be continuous and not broken at any point. Considering that in some

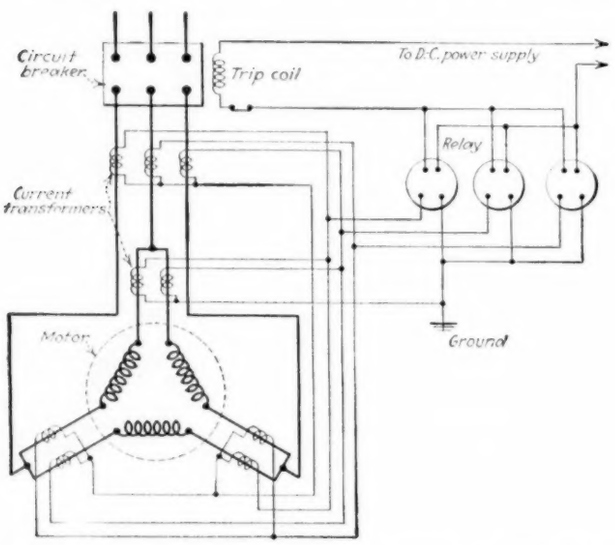


Fig. 3—Connections, using nine current transformers for differential-relay protection of delta-connected motors

stations several tons of coal per minute may pass through the plant, it can be appreciated that the failure of any one section to take care of its load for a very short time would pile up the coal on some other section, causing much confusion and delay in clearing the congested section. Hence, sequence of operation is imperative; that is, some provision must be made to insure that the preceding equipment is operating before the flow of coal is started. For example, the bunker conveying equipment must be running before the crusher starts and the pulverizer exhauster must be running before the pulverizer mill starts. To achieve this, some form of interlocking may be used.

A double set of control switches should be used, both sets being subject to the sequence operation. One set of these switches should be located at their respective motors and the other set in some central place, grouped in a comprehensive manner consistent with the physical

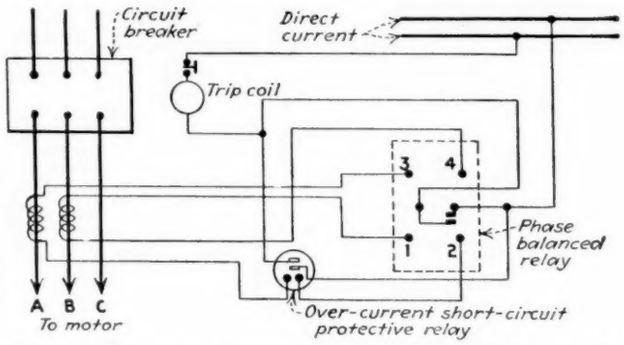


Fig. 4—Diagram of connections for phase-balance relay

layout of the pulverized-fuel plant. A trip bus should be provided for paralleling all conveyors with emergency stop switches placed at suitable intervals and any one stop switch controlling the whole system.

Sources of Power for Motor Drives

It is generally conceded that reliability is the most important factor to be considered in pulverized-fuel applications. Continuity of service of the entire system may be dependent upon the particular station auxiliary supply involved. The ever-present tendency to reduce costs should not be permitted to jeopardize reliability for any slight saving. Costs, which include first cost, maintenance and operating costs, will be appreciably reduced, yet the highest degree of reliability maintained by making the drives and control as simple as possible consistent with the work they are to perform.

The source of electric power for the supply of auxiliaries is a paramount factor in the determination of continuity of service.

In general, the following sources of power are used in general practice:

1. Main busbars through transformers.
2. House turbines.
3. Shaft generators.
4. Transformers connected to generator leads.
5. Supply from another station by means of a feeder not directly connected to the main busbars.
6. Direct current with storage-battery reserve.

In most central stations no one source is used throughout, but a combination of the sources just enumerated. The various advantages and disadvantages of each method are generally known and are only briefly touched on at this time.

No. 1 is the cheapest and most economical method, but is subject to interruption coincident with power system disturbances.

No. 2 is not affected by system disturbances, but is subject to large voltage drops when starting large motors of the full-voltage-starting type. It also has low economy compared to main unit supply.

No. 3 is not affected by system disturbances and has higher economy than method No. 2. On full-voltage

starting of large motors there will be large voltage drops, and it is subject to interruption if throttle of main unit is tripped.

No. 4 is low in cost, simple, reliable and not subject to such voltage drops as with methods 2 and 3, but is subject to system disturbances as with method 1 and possible throttle interruption as in No. 3.

No. 5 is not often used, each station being made self-starting and self-sustaining. It is used in some cases as emergency supply.

No. 6 is used for some drives and control, but the general practice is away from direct-current drives wherever possible. Where this system is used, the storage-battery reserve gives a high degree of reliability.

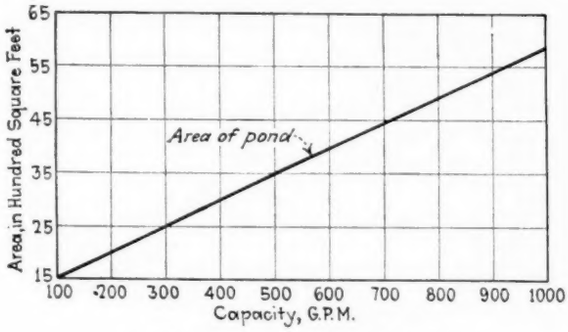
The general practice in the adoption of voltages for electric drives is 2,300 volts for the motors above 50 hp.; 550, 440 or 220 volts for the smaller motors up to 50 horsepower.

It is common practice to use double auxiliary busbars or sectionalized busbars for the supply of the more important drives such as fuel feeders, screw conveyers, forced- and induced-draft fan drives. Individual feeder lines are usually provided with some form of overload protection, which, on feeders supplying motors of the full-voltage-starting type, must have a high time setting. Fuses have been extensively used for overload protection. In some cases the motor circuit breaker or contactor is not large enough to interrupt short-circuit current so that whatever tripping device is used on it must be modified to trip out the feeder breaker.

Costs of a Spray-Pond Cooling System

By R. H. Emerick

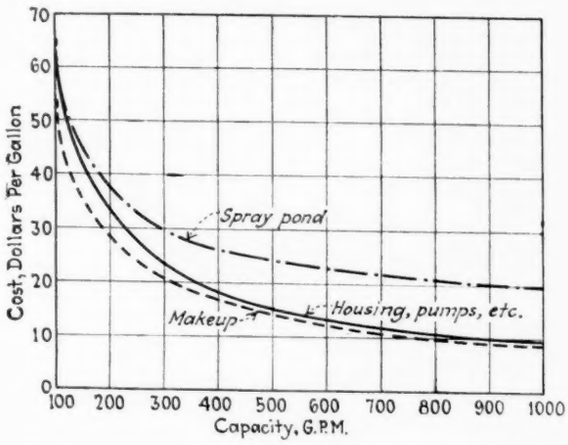
A SPRAY-POND cooling-water system is formed logically of three distinct sections. The first of these sections is the basin itself, containing the spray nozzles and their supporting columns together with safety fencing; the second section is represented by the system of makeup water, including artesian wells, air compressors, air and water piping and so forth, while the third and completing section includes pumps, foundations, pump and compressor housing, electrical service to motors, float control valves and all relative equipment. The cost curves presented herein have been prepared on the basis of this sectional division, with the thought in mind that one inclusive curve would offer little value where a different system of makeup might be desirable or new pumping equipment unnecessary.



Capacity versus area of pond

The pond construction in this case is of concrete throughout, reinforced and buttressed as required. In depth it ranges from 3½ to 4½ ft., which creates sufficient storage capacity to maintain service for approximately three hours if a condition of zero return and zero makeup were to arise.

The design of a spray pond is affected to some extent by the operating requirements set by the temperature of the warm water. As a rule, water fed to the spray nozzles should be within 25 deg. F. of the water leaving the pond on its cooling mission, and where a greater range exists, the mixed spray system becomes necessary. Thus, when water to a bank of transformers, for example, increases 44 deg. F. in temperature, an equal quantity of cool water must be added to it before spraying, which would in effect reduce its temperature at the nozzles to 22 deg. F. above that of the pond. Under such conditions there should be a small mixing well partitioned in the one corner and connected to the pond through a level equalizing pipe. The hot water is then discharged directly into this well, and spraying pumps, operated at a speed sufficient to handle twice its volume, take their suction from the well, the difrefence between the supply of hot water and the withdrawal of the pumps being made up by the inflow of pond water through the equalizing pipe.



Curves showing costs, based on capacity of the several components

While the pond cost curve represents this type of mixed spray system, a fair idea of single spray values is easily obtained by simply doubling the capacities noted, as the cost of the hotwell represents only an unimportant percentage of the whole.

The makeup system contemplates the employment of artesian wells with an air lift. The makeup required averages about 2 per cent of the total quantity sprayed, and an air lift is both satisfactory and much less costly than a pump for this quantity. The curve will permit a cost comparison with makeup from city water or other possible sources.

All equipment in the third curve is motor driven, and the housing is of slow-burning construction and represents the minimum in size.

No attempt has been made, in any of the curves, to consider land costs. That factor is purely local and will vary from the negligible to the prohibitive. However, an idea of the pond area may be of help in determining the land factor, and the fourth curve is given for that reason.

Turbine and Plant Efficiencies at Lilla Edet Station

By R. H. Andrews*

At the recent sectional meeting of the World Power Conference at Basel, in the course of the discussion on modern hydraulic turbine developments, H. Munding, of the Royal Board of Waterfalls, Stockholm, showed efficiency curves obtained with Kaplan and propeller-type turbines, in the low-head plant at Lilla Edet, on the Göta River in Sweden.

The generating equipment of the Lilla Edet station[1] consists of one 11,200-hp. Kaplan turbine (No. 1 unit) and two 11,000-hp. propeller-type Lawaczeck turbines

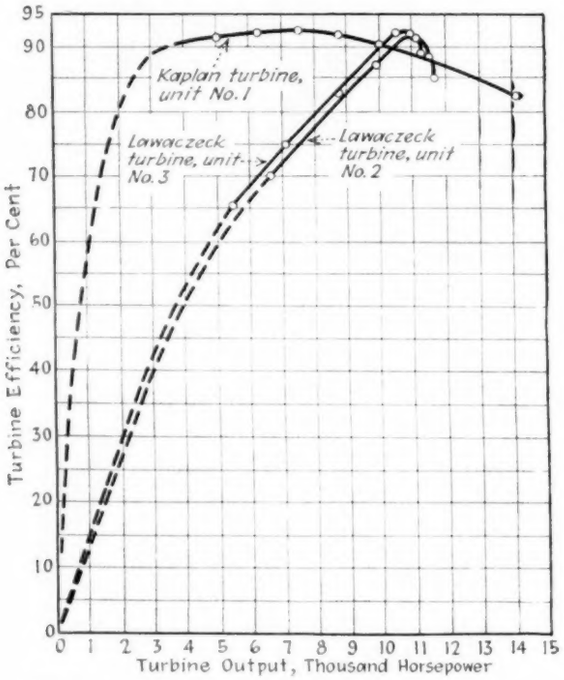

Kaplan turbine, unit No. 1
Lawaczeck turbine, unit No. 3
Lawaczeck turbine, unit No. 2
Turbine Efficiency, Per Cent
Turbine Output, Thousand Horsepower

Fig. 1—Efficiency curves of the three turbines in Lilla Edet station in Sweden

These efficiencies are figured on the European principle, according to which, the kinetic energy of the water leaving the draft tube is charged against the turbine.

(Nos. 2 and 3 units), operating under a 21-ft. head. The efficiency curves for Nos. 2 and 3, Fig. 1, are typical of the propeller type, with a sharp peak at full load. The maximum efficiency of No. 2 remains above 90 per cent between loads of 10,400 and 11,400 hp., or over a range of 9 per cent of its rated output. On No. 3 unit the efficiency remains above 90 per cent between 10,100 and 11,200 hp., or over a range of 10 per cent of its rated output. As compared to these units, the performance of the No. 1 wheel reaches 92.5 per cent efficiency and remains above 90 per cent between loads of 3,500 and 10,100 hp. or for 60 per cent of its rated output.

Fig. 2 illustrates the method followed to make use of the high efficiency of No. 1 unit at part loads, in handling an increasing station load of from 20,000 to 37,000 hp. Curves are given for the distribution of the station load between the three units, and the over-all mechanical efficiency of the plant. Between 20,000 and 23,000 hp., the station load is carried by one of the propeller units operating under a constant load of 11,000 hp., its most efficient point, and by No. 1 unit, carrying the variable load of from 9,000 to 12,000 horsepower.

At 23,000-hp. load No. 1 unit is overloaded and the station efficiency has been reduced from 91 to 87 per cent. The second propeller unit is then put into service and the load on No. 1 is reduced to 4,000 hp., which is close to its lowest economical load, the remainder of the station load being divided equally between the two propeller units, each taking 9,500 hp. The three generating units are now working near their lowest economical loads. As the station load increases, the load on No. 1 unit is held at 4,000 hp., while the two propeller units are gradually brought up to full load of 11,000 hp. The station efficiency has now risen from 87 to 90 per cent. While the propeller units remain

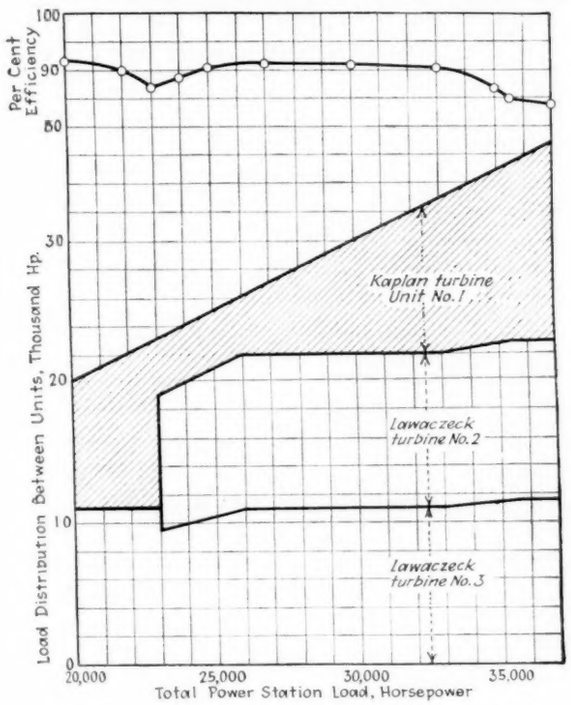

Per Cent Efficiency
Load Distribution Between Units, Thousand Hp.
Kaplan turbine Unit No. 1
Lawaczeck turbine No. 2
Lawaczeck turbine No. 3
Total Power Station Load, Horsepower

Fig. 2—Curves of load distribution and of station efficiency

at full load, No. 1 takes the balance of the station load, until its own load reaches 11,000 hp. During this period the station efficiency reaches 91 per cent. This is the full-load point of the station, 33,000 horsepower.

As the station load continues to rise above 33,000 hp., the overload must be distributed among the three units in such a way as to hold the station efficiency as high as possible. This is accomplished by gradually raising the load on the propeller units respectively to 11,500 and 11,300 hp., while the load on the No. 1 rises from 11,000 to 14,200 hp. The whole range of station loads, from 10,000 to 37,000 hp., has therefore been handled by the three generating units at good efficiency, with a load variation of less than 2,000 hp. on units 2 and 3.

The writer is indebted to the courtesy of A. Ekwall, chief engineer, and H. Munding, both of the Royal Board of Waterfalls, of Stockholm, for the curves and data given.

*Paris representative of *Power*.

[1]The Kaplan turbine is of the propeller type with the blades arranged so that their pitch can be changed automatically with change of load on the unit. A Lawaczeck turbine is somewhat similar to a high specific-speed Francis unit with the band at the ends of the buckets cut away.

Firebrick Specifications

THE American Refractories Institute, in its recently issued Bulletin No. 3 presents tentative specifications for clay firebrick for malleable furnaces and annealing ovens. This is the first specification prepared by this organization, and, while it does not refer to boiler furnace refractories, it will interest the readers of *Power* to know that the Institute is working on the preparation of specifications and that one may look forward to their consideration of refractories for the boiler room.

The preliminary remarks on the purpose and utility of specifications point out that the buyer is not thereby relieved of all responsibility in the selection of refractories best suited for his particular practice. "Of the brands which may meet the requirements, some will give better service than others. One brand may give best results in one plant and another in another plant, and a given brand may give highly satisfactory results in one plant and fail to do so in another. The reason for this variability in results lies in the almost countless combinations of conditions which exist in plant operation." This statement applies equally well to boiler-setting practice, and it is gratifying to observe that the Institute is attacking the problem sanely and intelligently.

The remainder of the document discusses technical detail of requirements for brick to be used in furnaces and annealing ovens, where the requirements are different from those in a boiler setting. It is to be hoped that the Institute will lose no time in prosecuting this work with reference to all fields in which refractories are used.

On another page of this issue is the second of two articles discussing the preparation and use of specifications for boiler furnace refractories. The subject is much alive, owing to the rapid increase in severity of service during the last few years.

Two-Stage Combustion

THE proposal to carry on combustion in two stages in separate furnaces is not new, but has come up again in a recent engineering society paper. The author proposes to burn half of the fuel, preferably in pulverized form, in the first combustion chamber with highly preheated air, thereby producing temperatures suitable for usual refractories. Products of such combustion would pass through the first section of the boiler and into a second combustion chamber, where the remaining fuel is added and the flame temperature again brought up to the desired point. The gases would then pass over the remaining boiler surface and at a relatively high temperature enter a large air preheater. Total boiler surface would appear to be less than in usual practice. The air preheater would lower the flue gases to a temperature such as to make them represent a final loss of about two per cent.

Two-stage combustion is primarily a means to enable highly preheated air to be used in furnaces with ordinary refractory walls. The total volume of the two combustion chambers may permit some savings in first cost and maintenance over a single large one-stage furnace.

Effective combustion in the second furnace can result only from an intimate mixture of fuel with products of combustion from the first stage, which would be deficient in oxygen. Hence violent turbulence would be required in the second chamber to insure intimate contact of each fuel particle with its necessary oxygen for complete and rapid combustion. Such turbulence might be difficult to maintain. If it is not possible, then the resultant slow combustion will demand a large furnace volume, in which case the total volume of the two-stage unit may exceed that of an equivalent single furnace. Furthermore, the effect of the radiant heat absorption by the tubes of the two sections of the boiler would affect the performance of the second stage and also the heat-absorbing surface necessary in the whole boiler. Two-stage combustion also presents problems in control, particularly at light loads.

It is claimed for all-metal water-cooled furnace walls that they permit the use of highly preheated air. The radiant heat absorption of the metal walls also reduces the boiler surface required so that this may not exceed that suggested for the two-stage arrangement. The question then resolves into one of relative costs of the two-stage furnace design and the metal-inclosed furnace and boiler.

Two Heads Are Better Than One

IT OCCASIONALLY happens, though fortunately not often nowadays, that a management refuses to permit its power plant to be inspected by outside engineers or described in technical publications. If the plant is not up to par, this diffidence is easily understood. No one likes to take a friend into a dirty back yard. But granting that the plant is worth while, it is hard to justify such an attitude of reserve.

The "trade secret" argument, weak at best, may perhaps be applied with some show of reason to a new chemical process of which one's competitors are supposed to be ignorant. It cannot have appreciable weight in the power plant. The power-plant field covers not one industry, but all. The little kink that saves money in one plant will help cut costs in countless others. Only a small fraction of the plants benefited will lie in the given industry. In other words, the publication of such information will boost the entire national prosperity, while competitors will get only their small share of this general gain to everybody.

The only way to keep industry growing is for everyone to play his part when his turn comes (which isn't often). It is safe to say that any nation where the imagined self-interest of individuals throttles the free

exchange of technical information will soon be on the down grade industrially. Fortunately, there is no need to get particularly excited over this problem, as it does not exist here in an acute form, at least not in the power-plant field. Yet a few remain who imitate the "cat who walked by his wild, wild lone."

Chiefly a Problem of Voltage Control

AT THE Richmond meeting of the American Society of Mechanical Engineers the interconnection of central stations with large industrial plants having excess power, as a byproduct from process heating, came up for discussion. One of the objections raised against such an exchange of power was the possibility of the industrial plants transferring their inductive load on to the central-station system. This objection, however, is more imaginary than real. In general, large industrial plants have capable operating staffs and can be depended upon to carry out an operating schedule.

As to the control of the inductive component of the current between two systems, this is only a matter of voltage regulation, the same as the distribution of the reactive component between two or more machines operating in parallel in the same station. The machine that tends to have the highest voltage will tend to supply a greater part of the lagging current of the system. Instead of the large industrial plant, if connected into a public-service system, dumping its wattless current on the latter's lines, there is no reason why it cannot be made to carry part of the inductive load of the utility power system. This would tend not only to cut down the transmission losses, but also to improve the voltage in that part of the system.

In one instance where an industrial hydro-electric plant is interconnected with a central-station system as recently described in *Power*, the generators were made fifty per cent larger capacity than the waterwheels. The voltage control of the generators was arranged so that the machines always carry their full kilovolt-ampere load, irrespective of the quantity of water available to operate the turbines. In this way the industrial power plant is made to raise the power factor in that part of the system about eight per cent in addition to improving the voltage regulation.

In many industries there is an excess of waste heat or waste fuel or both, that can be converted into power at a cost lower than that of fuel in most large central stations. Where power can be generated on the upper end of the heat cycle of process steam, a kilowatt-hour can frequently be produced for about five thousand heat units, which is about one-third of the heat required to produce the same unit in the most efficient condensing plants. Modern cement mills equipped with waste-heat boilers on the kilns, are capable of producing, at times, fifty per cent more steam than is required for power purposes. The only additional cost to convert this into power, if a load were available, is that for generating equipment. In many cases the reserve capacity of the plant would be sufficient, so that anything that could be obtained for this power would be clear gain.

Tying a large number of little industrial plants into a central station system may well have its serious objections. There are, however, many large plants of this type where such interconnection could be arranged to good advantage and such interconnections do exist now. Unfortunately, they are the exception and not the rule. There has been a great deal of discussion about fuel conservation, but as long as fuel is burned to supply power that can be produced as cheaply, or at a lower cost from waste fuel and heat, the sincerity of such discussion is open to question.

A Word on the Oil Supply

NEWSPAPER headline writers' sole reason for existence is their ability to find, somewhere in a story, a thought or idea that will rivet the layman's attention to the page. Sometimes their activity goes so far as to produce a headline at contradiction to the body of the story. Something like this happened to the report of the federal committee investigating the oil situation. Practically the entire public was more or less deceived by the headings given the report, most of which stressed the idea that the oil supply was good for but six more years.

How far this represents the opinion of the committee can be learned only by a close reading of the report. It was agreed that the visible supply was sufficient for only these few years, but the statement was not intended to be a prophecy as to future developments. Deeper drillings, more economical handling and new pools will undoubtedly serve to supply oil far beyond the alloted time.

A further ray of hope to the pessimistic should be the opening of the government shale-oil refinery in Colorado. As has been mentioned many times, the visible shale in Utah, Colorado and other Western States is a guarantee of a supply of oil for generations to come. True, the recovery and refining of shale oil is more costly than in the case of petroleum, but this increased cost will lead to a more economical use. Moreover, the carbonization of bituminous coal is now making headway in this country, and here is another large potential petroleum supply.

Conservation is basically admirable, but there are many who argue with some justification that those who are alive today should not be expected to forego the benefits of a cheap fuel in order that those who are to come may be so blessed, although waste is to be discountenanced at all times.

The energy of the oil industry should be centered on the reduction of loss in the oil from the time a pool is discovered until it reaches the consumer; also in its efficient use. It is here that the great opportunity lies.

Pulverized Coal and Public Fancy

COAL will produce more heat per pound than oil. So great is the magic of pulverized coal! According to the daily press this startling assertion was made by a competent engineer in an address to a group of shipowners, including harbor tugboat operators. And of course the public believes it all.

The layman gets his knowledge of technical developments through the medium of reporters whose appreciation of the spectacular surpasses their comprehension of the facts. Unhappily, the layman is prone to accept garbled reports with implicit confidence, and sometimes serious harm results.

The engineer who is able to detect such occasional fallacies has a duty to the public. By whatever means he may, he must strive to disseminate the truth. At least he can tell his friends what he knows.

Practical Ideas From Practical Men

Cutting Down Operating Expense by Installing Steam-Flow Meters on Steam Line to Services

The average power-plant operator keeps a fairly close record and check on the amount of fuel burned, the quantity of steam produced, the effect of different kinds of firing, etc., but few are taking cognizance of the further possibilities for over-all economies that may be obtained by carefully checking the actual use and distribution of the steam. Often it will be found that steam is being used wastefully and unnecessarily because the steam valve is handy and the supply of steam apparently inexhaustible.

Especially is this true in a plant where a variety of uses for steam arises, as in hotels, hospitals, etc. Plants of this kind offer good opportunities for savings because usually the operators of each department are interested primarily in their own results and convenience and care little for economy in those things for which they are not held directly responsible.

If the laundry or the kitchen of a hotel uses large quantities of steam, it is only logical that that particular department ought to have the steam charged to its own operating account rather than against the cost of power. Most operators realize this, but often do not go far enough, in that they attempt to apportion what they think is a nominal charge for the steam furnished. This helps to relieve the power plant of the burden, but it does not show up how and when the steam is used.

One of the most convenient and helpful checks against the use and abuse of steam by various departments is to install steam-flow meters on the supply lines, so that the steam can be measured and recorded and then charged to the department at a proper cost rate. Not only does this result in a fair and proper carrying of the cost, but it also eliminates wasteful and careless use of steam.

In our hotel we recently installed a steam-flow meter on the steam line leading to the laundry. After getting the meter in service we took a few days' run of charts in order to get a representative and average one, and the chart, Fig. 1, is a typical one showing a steam consumption, during a 24-hour period, of 46,090 lb., based on the planimetered chart record and checked against the integrator counter record on the meter.

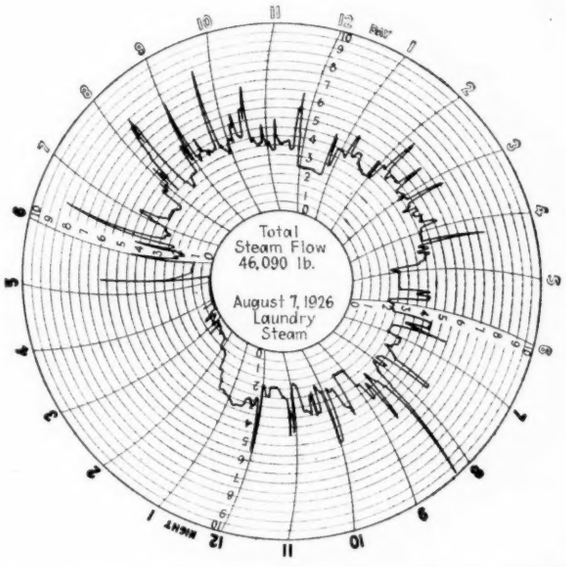


Fig. 1—Flow-meter chart showing steam consumption before investigation was made

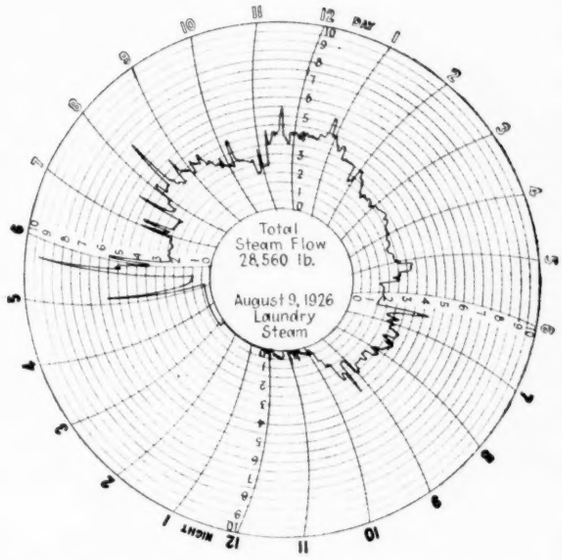


Fig. 2—Chart of steam flow after wasteful use of live steam was stopped

We were interested in the heavy draw of steam which took place regularly all day, and on investigating found that the operators of the washing machines were discharging live steam into the washers in order to heat the water quickly, whereas hot water, of a proper temperature, was available for the purpose from our hot-water generators, which were being operated on exhaust steam at no cost because we had an excess supply of steam.

We took the matter up with the laundry manager and pointed out that by changing his method of operation slightly he could not only cut down the quantity of steam with which he was being charged, but would enable us to show an over-all improvement in our operating cost.

The change was put into effect, and the result is shown by the meter chart, Fig. 2, which indicates a steam consumption of only 28,560 lb. for the same period,

and a noticeable cutting down in the momentary drawings on the steam.

The results shown by these charts are typical of what we have accomplished in some of the other departments —for instance, in the kitchen, where, by taking a chart record before making a study of the steam use and then taking a chart record after we had gone over the kitchen, checking up on the tightness of the traps, etc., we were able to show similar reduction in the quantity of steam used. We found several traps which were bypassed and blowing steam because the kitchen crew opened and shut the valves without clearly understanding what the effect was, which made it necessary for the engineers to check up on them from time to time to make sure that the valves were properly set.

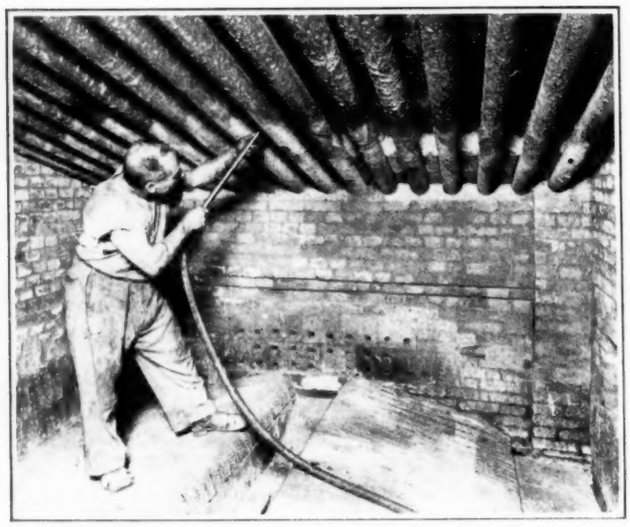
This experience indicates clearly that it is good policy to equip the steam line to each major operating department with a reliable steam meter, so that each department can be charged with the steam it uses, and so that comparisons and check-ups can be made from time to time in order to show up wasteful practices or leaks. Then there is the moral effect of better operation and more care where the attendants know that what they are doing in the way of steam use is being put down in red ink on the meter chart. We believe that these steam meter installations will pay for themselves in a year's operation, and as they can be readily installed and looked after by the operating crew in connection with their regular duties, they do not require any additional investment for care-taking.

J. C. PHILLIPS, Chief Engineer,
Philadelphia, Pa. Benjamin Franklin Hotel.

Repairing Leaky Baffles with a Refractory Gun

Owing to the limited boiler capacity at our plant it is necessary that the boilers operate at high efficiency. Some time ago we found that considerable loss in efficiency was due to leaky baffles, and after several unsuccessful attempts to seal the leaks by hand methods, we decided to try the refractory gun for this purpose.

We first repaired the front baffle on one of the 4,000-sq.ft. boilers, using a mixture of crushed old firebrick and high-temperature cement. With a ¾-in. nozzle, 4 ft. long, we reached up between the tubes in the first pass and applied the mixture first in one diagonal direction and then in the other. By this method we reached the entire front surface of the baffle. A slight turn of the nozzle right or left, while shooting the mixture, completely sealed the cracks and spaces around each tube.



Hose nozzle reaches up diagonally between the tubes and applies the refractory mixture to the baffle surface with great force

We also "gunned" the bridge wall, which had an irregular crack 2 in. wide through the middle of it. This work was begun four hours after the fire was drawn, and all repairs to the bridge wall and baffle were completed in about 2½ hours. Fire was again started as soon as the job was finished, and we noticed an immediate improvement in the furnace efficiency.

In the adjoining 4,000-sq.ft. unit the lower part of the front tile baffle had just been rebuilt and a new stoker installed. We decided to "gun" this entire baffle and applied the plastic mixture over the new tile as well as the old part. To reach this surface, the plastic material was shot through 40 ft. of hose to the nozzle.

We also repaired the rear baffle in the same boiler to save rebuilding. It was close quarters to work in, as the space between the top row of tubes and the drum is only about 2½ ft. We used 60 ft. of hose with a 4-ft. nozzle and repaired this baffle from above, bringing the hose around the boiler and through the upper clean-out door.

The mixture used was 5 parts crushed firebrick to 3 parts of high-temperature cement, which we mixed in a mortar box, first diluting the cement with 2 parts of water. We mixed it well and then added the crushed firebrick brought down to ¼-in. mesh including fines. We used a specially prepared crushed old firebrick, higher in cost than the average, and figure that the entire cost of plastic mixture was about two cents a pound.

P. R. INGLIS, Power Plant Supt.,
New York City. Ward Baking Co.

Replacing Steel Stacks

Having seen considerable damage done to various plants when taking down steel stacks, I should like to mention a few pointers about this work. Look the stack over carefully, especially at the central portion. The joints are usually the weakest spots, and as the present practice is to set the stack with the laps outside looking up, quite often the joints appear to be solid, as the paint has piled up on the exposed edges of the iron.

Should the joints be in bad shape, or in fact any part of the stack, the safest method of taking it down is either to make a plank girdle around the stack and put a line around this girdle or, better still, if the gin pole is long enough, let the line down inside the stack and burn a hole through the bottom of the stack large enough to pull the end of line through and make a slip hitch around it. Even if every joint should fail, when handling a stack by this method, no damage can result, as the stack will be strung on the line.

Where no outside crane is available in putting up the gin pole, use a good house derrick, and be sure to use a pole of sufficient length and strength. Also, instead of the usual outside guy bands, which cause the stack to rust at these points, use eyebolts with a diamond plate both inside and outside the stack at each bolt.

Duluth, Minn. G. W. KAY.

Comments from Readers

Welded Pressure Vessels

In the issue of August 31 there is a letter from A. J. Lamie in which reference is made to some articles that I have written in connection with welded pressure vessels. It is always a difficult matter, and possibly not entirely fair to an author, for someone else to express the author's views without making direct quotations so that the reader may see exactly what the author has said. Mr. Lamie has stated my position in the following words:

> He took the position that the society should not produce codes that deal with engineering matters from a public-safety point of view, but that its codes should consist of specifications based on the very latest engineering methods, without attempting to restrict the general use of such methods by everyone, by injecting a safety factor sufficient to compensate for poor application of method.

I should be glad to have Mr. Lamie reconcile this statement with the following quotations from my article in *Mechanical Engineering:* "In other words, the author's conception of a code is that it is a description of the minimum allowable requirements for safety," and "A code differs from a specification in that it is written primarily as a safety measure."

It would, therefore, seem that Mr. Lamie's statement of my position is not correct. I also think it would be fairer to say that, if the code that I proposed were adopted, it would give *properly* welded tanks an equal standing with those of riveted construction. I certainly have never advocated giving what I consider improperly welded tanks any rating at all.

I might further say that my proposed code is based on work done in commercial shops, the results of which are given in Bulletin 5 of the American Welding Society, these results being those of the tests made by the Bureau of Standards, and further, that these results are so far behind what has been accomplished in the laboratory that there is no comparison. In other words, it does not "set up as a standard the ultimate in scientific achievement," nor does it even set up as a standard what is being done in the best commercial practice, because I agree with Mr. Lamie that neither of these can be used as a standard.

In Bulletin 5 referred to herein, the committee of the American Welding Society made certain recommendations based on the tests, of a factor of safety of 5 and a weld value of 80 per cent, using 50,000 lb. ultimate strength of the plate as a basis, and insisting on the use of the double-V-weld for longitudinal seams. These same recommendations are used in my proposed code.

Mr. Lamie states, "I have seen dozens of welded air tanks that exploded under normal working pressure." I believe he would confer a favor on everyone if he would make up a list of these tanks, giving the circumstances and the result of the investigation with a complete description of the tank and weld. This list could be compared with my proposed code to see if tanks made in accordance with the latter had given any trouble. I might say that I have repeatedly tried to get similar information and have never been able to.

S. W. MILLER,
Union Carbide and Carbon Research Laboratories, Inc.
Long Island City, N. Y.

High-Pressure Steam in Heating Mains

The article on the new heating plant at the University of Rochester, by Prof. J. W. Gavett, in the issue of Aug. 10, interested me. There is one feature in the steam distribution to buildings upon which I should like to make some comments.

The article states that it is the practice to carry steam to each building at full boiler pressure, reducing in one step in the building to one or two pounds for heating, and to 25 lb. for other purposes. The writer does not approve of this practice for a number of reasons. Pressure-reducing valves are not infallible, and if for any reason one of these fails to function, steam at full line pressure may be admitted to the heating system. Besides the damage to thermostatic traps, a serious accident due to the bursting of a radiator is likely to follow. The writer has had some unpleasant experiences along this line in years past, when it was the practice at the University of Missouri to carry full boiler pressure, 100 lb. or more, to each building, there to be reduced to building pressure, exactly as described in the Rochester article.

Our present practice is to reduce from boiler pressure, which is 150 lb., to a pressure of 30 to 40 lb. at a point in the steam tunnel near the power plant. Steam at this reduced pressure is carried through tunnels and underground conduits to some nineteen buildings having a total of about 71,000 sq.ft. of radiation. A recording pressure gage in the office of the Superintendent of Buildings records this pressure, giving instant notice of any change up or down. In case a pressure-reducing valve in a building should get out of order and permit the full pressure on the building, this pressure cannot exceed that which is carried in the steam mains.

We find it advantageous for other reasons to carry just as low a pressure in the heating mains as possible, consistent with an ample supply of steam to each building. Reduction of pressure at or near the power plant tends to dry and superheat the steam, thus reducing troubles due to accumulation of water in the pipes. The writer believes that the high steam velocities brought about by the reduction in pressure are of advantage.

The lower temperature of the low-pressure steam is another thing in its favor. The temperature of saturated steam at 30 lb. gage is 274.5 deg.; at 150 lb. it is 366 deg. The loss due to radiation in long lines extending to distant buildings will evidently be much less in the former case than in the latter.

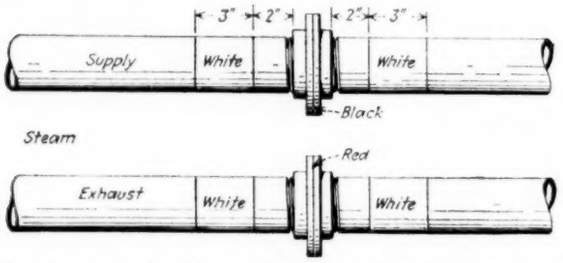
Columbia, Mo. A. L. WESTCOTT,
Superintendent of Buildings,
University of Missouri.

Painting Pipe Lines

The following comments are inspired by the recent articles on painting pipe lines together with a recent visit to a plant where the pipe lines are painted, causing some sections of the plant to look like a rainbow or an eye test for colors, such as one gets when one joins the Army or Navy.

I am at present employed by a consulting engineer who recently had charge of the design and installation of all mechanical work and equipment in connection with the office building of a large public-utility corporation. In connection with the piping and painting thereof I made use of a lesson learned in the United States Navy during the World War.

Anyone who has ever been privileged to visit the engine room of a U. S. Naval vessel has probably noticed that all pipe lines were painted to match the compartment they were in, usually white, with colored bands at the flanges, or at intervals of 10 or 15 ft. in pipe with screwed fittings. This is the exact procedure I followed on this particular job, using the U. S. Navy



Bands on each side of the flanged union designate the material carried

Standard Color Code, except that I used 3-in. wide bands instead of 4-in. This code can be adapted with suitable variations, to any plant, and is easily memorized.

The flanges of all supply or suction lines are painted black, and the flanges of all exhaust or delivery lines are painted red. Then a band 3 or 4 in. wide on each side of the flange indicates the material handled, as follows: Steam lines, white; salt water, green; fresh water, lead color; hydraulic piping, rams, etc., blue; ventilation piping, yellow; fuel oil, three 2-in. bands—red, white, red; air lines, black; fire lines, red.

If a line is used for common suction and delivery, paint one flange red, the other black, in the direction of respective flow.

Another practice, standard on most ships, is that of having all valves labeled. A brass disk about 3 in. diameter is stamped with the label, as for example: "B. F. Suction," or "L. P. Steam-Bldg. 4" in the case of a plant supplying several buildings. This disk is placed under the nut holding the valve wheel in place. Especially on shipboard is this practice valuable, for sometimes a new man comes aboard shortly before sailing time and goes on watch at once. In such cases the labels are a necessity.

One reason for their lack of popularity on land lies with the engineers themselves; also partly with the employers. An engineer who knows his plant thoroughly doesn't need them, and why should he make it any easier for another man to come in and take his place? Also, the employer sometimes takes the stand that the engineer doesn't have to know anything—"everything is labeled, anybody can run it." The real excuse for labeling valves and pipe is in large buildings, where lines pass through walls or floors, or up pipe shafts or chases in walls, and a new man would have to spend several weeks around a plant to find out where they all went.

I believe in installing such a system in all large plants, and it is standard practice in the office where I am employed to label all lines with color code on big jobs.

Boston, Mass. W. C. FRANKS.

Data Needed on Boiler-Room Performance

With reference to the editorial in the July 27 issue on "Data Needed on Boiler-Room Performances," I thought the following might be of interest.

I had occasion to visit a small plant recently containing two 2,250-sq.ft. water-tube boilers equipped with chain-grate stokers and burning anthracite culm of about 11,000 B.t.u. The water feed to the boilers is measured by a venturi meter, and the engineer has rigged up a device that records the amount of coal consumed by each boiler. His records check closely with the car weights and serve as a good guide to the amount of fuel used. He showed me his plant logbook, and from it I obtained the following figures, which give the monthly average from April 20 to August 20.

	Evaporation, Lb.	Efficiency, Per Cent
April	6.96	61.4
May	5.81	51.13
June	6.22	54.92
July	6.77	59.7
August	5.59	49.3

The efficiency given is for boiler, furnace and grate. The engineer informs me that the quality of the coal varies, and from what I could see of it, judging by the looks, the percentage of ash must be high, as it contained a lot of mud and dirt. This is due to the manner of loading from the bank with a steam shovel. I am giving this as a start in the line mentioned in the editorial.

THOMAS M. STREET.

Wilkesbarre, Pa.

At the plant where I am employed we do not go into any elaborate details as to costs, but we do weigh the coal burned and measure the steam generated. A daily log sheet is kept in the boiler room, covering the steam generated, coal burned, temperature of feed water entering heater, economizer and boiler, and from this daily log sheet a weekly report is made out. From this record the fuel cost to generate 1,000 lb. of steam and the over-all boiler efficiency are readily determined.

To get at the other costs, such as labor, repairs, supplies, etc., it is necessary to have some simple method of making and collecting the charges. These charges are variable and are not so easily compared to other plants. But boiler efficiency is comparable with any plant and is a basis on which one can compare the performance of his plant with any other.

The cost to evaporate 1,000 lb. of water varies with the price of coal (freight rates being a considerable factor), and therefore a comparison with other plants cannot always be made, but if a plant is operating at an efficiency of 75 per cent, it can be compared with any other plant. At the plant where I am employed we are getting an efficiency of around 80 per cent.

I hope this letter will bring out further discussion of the subject, as I know of no more interesting or important one.

C. W. FREDERICKS.

Bristol, Conn.

Bubbles in Ammonia Receivers

I have noticed bubbles in many liquid receivers in a great many plants and found that apparently most operators think that entrapped air is responsible for the bubbles rising in the gage glass.

It of course might be possible under certain conditions for air to produce the observed effect, but there is no doubt that in the majority of instances the bubbles are caused by envelopes of gas which are formed at or near the bottom of the liquid receiver, as pointed out by Anthony J. Wolff in the Aug. 24 issue.

It is evident that with a sufficient temperature difference between the air in contact with the receiver and the ammonia inside the receiver, gas will be formed due to the slow evaporation of the liquid, and as gas is formed it will naturally rise to the upper part of the receiver, above the liquid level.

I have observed bubbles in the gage glasses of several receivers where it was known that the entire ammonia system was entirely free from air or other non-condensable gases.

Recently, a case was discovered where the receiver was located in a warm room and frequently the evaporation of liquid was sufficient to cause this receiver to become gas bound and prevent the regular flow of liquid from the condensers by reason of the slightly higher pressure at times in the receiver than in the condensers. An equalizing pipe connection from the top of the receiver to the gas-inlet header overcame the difficulty. Where it is necessary to place liquid receivers in warm rooms or in the hot sun, they should be properly insulated.

C. T. BAKER.

Atlanta, Ga.

Fire Hazards with Pulverized Coal

I have recently read the Bureau of Mines Bulletin No. 242, "Explosion Hazards from the Use of Pulverized Coal at Industrial Plants," by L. D. Tracy, and I was impressed, as must all those be who consider the subject, by the numerous hazards that are considered inconsequential and matter of fact around the plant.

I have been an eye witness to two coal-dust explosions. One of these, which occurred at a coal mine, happened in the following manner: The coal bins at the hoist house had been run empty and over a lay-off day were being cleaned of the accumulation of dust and fine coal. A larry of the type commonly used in charging coke ovens was run under the bin and the gates were opened, allowing the dust in the bin bottom to drop into the larry. The steam dinkey engine had pulled away about twenty feet from the larry, when a sudden breeze blew the dust cloud which now hung around the larry down, enveloping the dinkey. The cloud at once flashed and burned throughout its length back to the larry. The spectacle of the blazing cloud of dust was uncanny. Fortunately, the bin gates had been closed and the cloud was not confined, so no one was hurt. However, a bad scare was thrown into the cleaners who had done this same job numberless times, never thinking of the tremendous hazard the dinkey engine fire caused.

The second explosion was of the sort commonly called a flare back, occurring on the operating platform of a large pulverized-coal-fired boiler. Tests were being run on the installation, and the boiler had been off the line for a minor repair. When it was lighted up again, the fuel in the bin had become damp and the fire would not catch. Although all ordinary precautions had been taken to ventilate the furnace, there must have accumulated a combustible mixture in the combustion space, for when the fire finally caught for a moment and blazed, there was a sudden flash and the whole section around the operating platform was a wave of fire. All the burner dampers had been opened in order to watch the progress of the lighting attempt, and each of these openings spouted fire like a blow torch. Of the five or six men, operators and spectators who were on the platform, I was the only one burned and that not seriously. The sensation of seeing the fire all around, and the absolute, even oppressive quiet that existed inside that envelope of fire were something to have experienced and to remember. But here was another time when a routine job exposed its hazardous nature unexpectedly.

At this same period of time, when powdered coal was a little newer than now, with a crew of men I spent the larger portion of one night inside a 60-ton pulverized-coal storage bin shoveling dust, raking and trying to get the coal leveled off above the feeder screws so that at the zero hour, when the bin should be almost empty, a test run might be started on the boiler unit, which was undergoing its acceptance tests. We were on the top floor of the station, and the bin about 20 ft. deep had a 3-ft. manhole and a long iron ladder for its exit. The dust was stifling, so that work could be continued for only about 15 minutes at a stretch, even with respirators. For illumination we had a 500-watt lamp, which at one time had been fitted with a vapor-proof globe, now gone, swung on the end of a long extension cord, bumping this way and that against the iron ladder. The glass was so hot the dust settling on it smoked, but we were all more worried with the trouble of breathing than the danger. We thought it took a spark to flash the dust. And in all verity it must be said that the officials at this plant felt every precaution was being taken in the work.

In a certain power station the boilers are so arranged that the stoker hoppers are fed through weigh larries. At one end of the boiler room an open carrier hoists the coal to the bins. Every week these larries are inspected and blown off with compressed air. Here is a fine hazard. Yet, it is probably felt that all possible precautions are being taken. Familiarity and insufficient knowledge of real hazards cause more accidents than all other kinds of carelessness.

There are now on the market vacuum cleaning systems designed especially for cleaning in plants of this kind, which are inexpensive enough to permit their installation in even the small power plants. Instead of blowing the piping and boilers off with compressed air, these systems collect the dust and eliminate the danger. There is a homely maxim to the effect that one's personality is evidenced by one's housekeeping, and every one admits that the cleaner the plant is kept the better mechanical condition it will likely be in. Following a little farther, the cleaner the house is the safer it will be and the more careful its inmates. One accident may do more to shatter the morale of a crew than any other thing. "Always Be Careful" is never more applicable than in places where a large amount of coal dust may accumulate. "Safety First" means "Safety Always."

CHARLES E. COLBURN.

Jeanette, Pa.

New and Improved Equipment

New Types of Reeves Variable-Speed Transmission

To broaden the field for the Reeves variable-speed transmission, making it more applicable to all types of variable-speed control problems and to improve application in restricted quarters, the

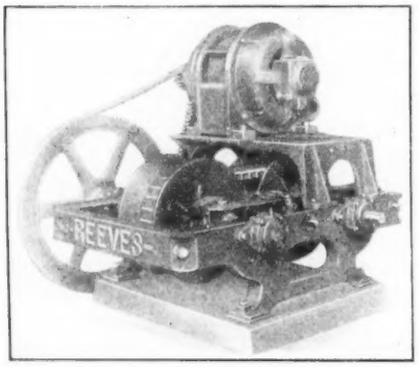


Fig. 1—Individual motor drive

several new arrangements shown in the accompanying illustrations have been brought out by the Reeves Pulley Co., Columbus, Ind.

Among the new developments attention is called to the individual motor drive shown in Fig. 1. This unit con-

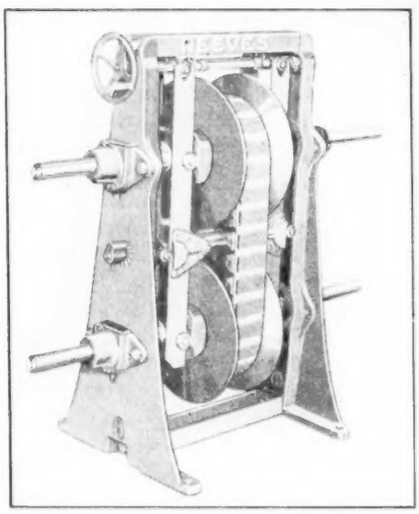


Fig. 2—Vertical type transmission

sists of the transmission with a constant- and high-speed motor mounted directly above the frame on a special base built to accommodate any standard type of motor. The feet of the motor base are slotted so that it may be adjusted to give alignment and take up slack in the silent-chain drive. It is furnished in sizes up to 50-hp. and in speed ratios of from 2 to 1 up to 16 to 1.

In a number of installations involving considerable speed reduction, it had been necessary to use an auxiliary countershaft. To conserve floor space, this auxiliary shaft has been mounted on the frame of the transmission. The connection between the variable-speed shaft and the countershaft is made with silent chain and sprockets, pinion and gear, or in some cases with roller chain and sprockets. With the double reduction of speed from the variable-speed shaft to the countershaft and from the countershaft to the machine to be regulated, a total reduction of as high as 50 to 1 may be secured.

To effect ease of control by the operator so that he need not leave his position to regulate the speed, remote controls of electrical and mechanical types have been developed, which permit regulation at any reasonable distance or from any number of stations. The

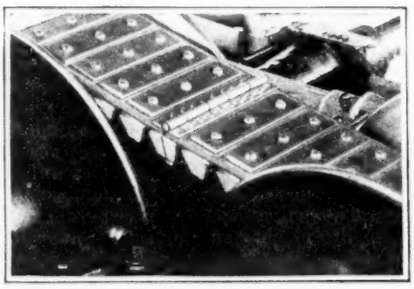


Fig. 3—Improved splice block for V-belt has steel hinge plates top and bottom

electrical control consists of a small reversible motor attached by spur gears to the shifting screw of the transmission. This motor is controlled from one or more push-button stations located at convenient points. In the mechanical control, gears are used and the speeds of the transmission are shifted at remote positions by pulling on "fast" or "slow" cables or by moving a lever at the transmission. The gear control obtains its power from the constant-speed shaft of the transmission.

For occasional installations where the standard horizontal type of transmission does not work in to advantage, owing to limited space or to the design of the machine that is to be controlled, the vertical frame shown in Fig. 2 has been designed to carry the transmission mechanism. The shifting screw generally is located at the top of the frame and may be operated by either a hand-wheel or a sprocket, chain and shifting crank, as in the case of the standard horizontal type. Both types of remote control, the automatic mechanical control and speed indicators also may be applied to this vertical transmission.

An improved type of split splice block facilitates the removal or application of the standard rubber-body V-belt to the transmission. It will be recalled that the V-belt is made up of a rubber belt body to which is attached at regular intervals hardwood blocks tapered at both ends and tipped with leather to conform to the V-angle of the disks. As shown in Fig. 3, the splice block is made up of two half-sections with steel hinge plates top and bottom for membering the ends of the belt together. Screws through these plates anchor the belt ends to each portion of the splice block, and the splice is secured by inserting pins above and below the joint through the eyes of the hinge.

Yarway Improved Spray-Pond Fittings

The illustrations show the improved line of spray-pond fittings brought out by the Yarnall-Waring Co., Philadelphia, Pa.

In this new line the shape of the distributor head has been changed from cylindrical to spherical form, as shown in Fig. 2. This form tends to give

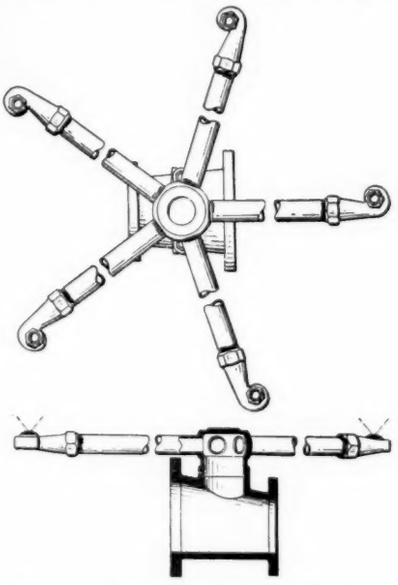


Fig. 1—Plan and section of five-arm spray group

better support to the spray arms when screwed into place, as it gives a full uniform thread. It also tends to lessen the pumping load due to friction. Fig. 1 shows plan and partial section of a five-arm spray group where the two-piece fitting shown in Fig. 3 is used. In this case a spherical distributor casting is bolted to a special

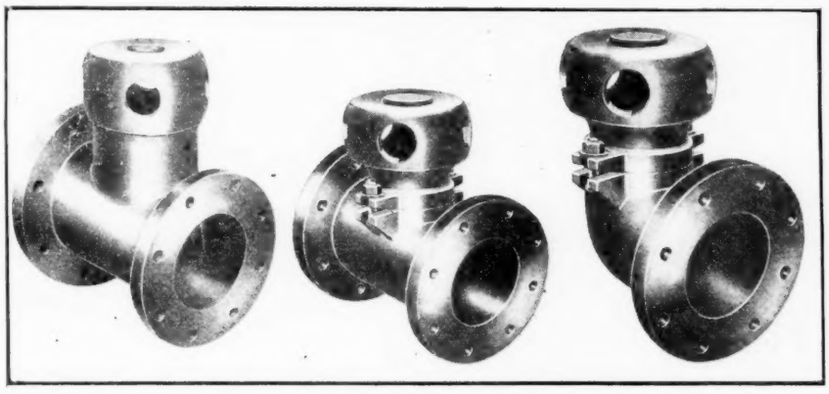


Fig. 2—Improved type A-tee with spherical head

Fig. 3—Type B-tee with separate distributor head

Fig. 4—Type B-ell for use at the end of the line

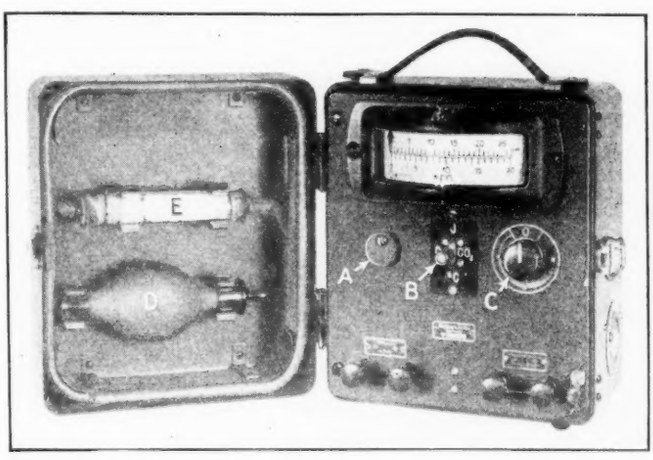
straight or eccentric tee. The type B-ell shown in Fig. 4 is placed at the end of the laterals or spray headers and does away with the necessity for a blank flange.

Bacharach Portable Electric CO_2 Meter

The Bacharach Industrial Instrument Co. has extended its line of gas analysis instruments to include the portable electric CO_2 meter illustrated. The principle of operation is the same as for the permanently installed meter brought out some years ago by this company, which is essentially as follows:

An electric current is caused to flow through two sets of platinum wires arranged in a Wheatstone bridge circuit. One set of the wires is in a metal chamber through which the flue gas is drawn and the other set in a chamber containing air at room temperature. The heat generated in the wires, by the current, is transmitted through the gases to the walls of the chambers, and as the gas containing the CO_2 transmits the heat less readily than the air, the wires in the gas chamber become hotter than those in the air chamber. This causes a corresponding change in resistance which unbalances the circuit and causes a deflection of the galvanometer to an extent depending on the percentage of CO_2 present.

The portable instrument illustrated consists of an indicator on which the percentage of CO_2 or temperature can be read, the bridge zero adjuster *A*, a tumble switch *B*, and the variable resistance *C*, for current adjustment. To set the proper bridge current, the tumble switch *B* is thrown into the upper position; this cuts the indicator into the circuit as an ammeter, and the current is set to the top mark deflection by means of the variable resistor. Three standard dry cells are used as the current source and connected to the two binding posts in the lower left-hand corner of the instrument. When making temperature measurements, the tumble switch *B* is thrown into the lower position, and with any standard thermocouple connected to the lower right-hand terminals the reading is made on the millivolt scale. By means of a millivolt-temperature curve the temperature is determined.



Portable instrument gives CO_2 and temperature readings

For the analysis of flue gas the tumble switch *B* is thrown into the center position. The gas is sampled by means of a hand aspirator *D*, which draws the gas through a small calcium chloride and cotton filter *E*, which, when not in use, is conveniently held in the cover of the instrument as shown. The instrument can also be arranged to give continuous indications for short periods. The dimensions of the case are 6½x7½x 9 in. and the complete instrument weighs approximately 14½ pounds.

Schutte & Koerting Herringbone Gear Pump

The Schutte & Koerting Co., Philadelphia, Pa., has recently brought out the herringbone gear pump illustrated.

The pump is built in two styles—the standard type with self-contained bearing as shown, designed to handle oil or other liquids of a lubricating nature, and a special pump with outboard bearings for handling water, chemicals or non-lubricating liquids.

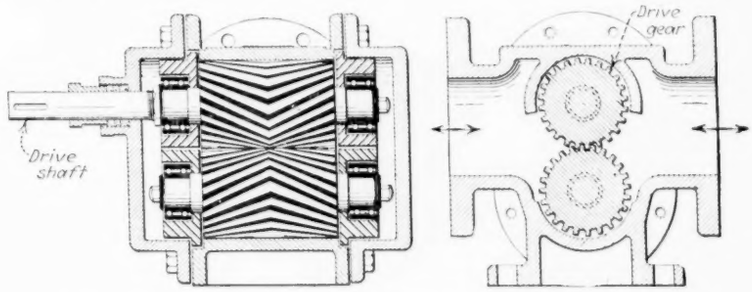


Fig. 1—Cross-section of pump showing constructional details

To insure rigidity, the gears are integral with the shafts. Both shafts are carried in ball bearings set in bearing holders which in turn are clamped between the body and end castings of the pump, as clearly shown. For special services the pump is equipped with a simple bypass arrangement to eliminate excessive pressure on the discharge side of the pump.

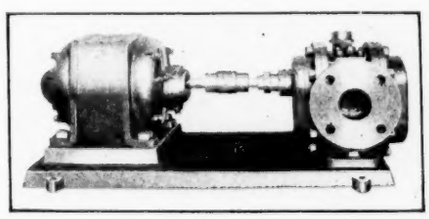


Fig. 2—View of pump assembly

The Village of Andover, N. Y., has entered into a contract with the Niagara, Lockport & Ontario Power Co., whereby current from Niagara Falls soon will be brought into that village. Under the terms of the contract the village is to take not less than 27,000 kw. per month.

Operation of Hydro and Steam Plants in Parallel

BY W. E. MITCHELL* AND J. M. GALLALEE†

IN 1912 the Alabama Power Co. began construction on a dam and hydro-electric power plant of 81,000-kva. ultimate capacity at lock No. 12 on the Coosa River. By 1914 there was installed 40,500-kva. capacity, and in the same year the construction of a steam plant of 12,500-kva. capacity was completed at Gadsden. In 1914 the maximum system demand in kilowatts was 23,500, the energy supplied, 58,000,000 kw.-hr., and the connected horsepower load, 47,000 hp. By the end of 1925 the maximum available installed capacity had increased to 381,000 kva., the maximum system demand to 270,000 kw., the energy supplied to 1,121,000,000 kw.-hr., and the connected load to 636,749 hp.

Since the inception of the system steam plants have been used to aid the hydro plants to carry the load and also to pick up any part of the load which is lost by a hydro plant owing to interruption from any cause. Not only are they used as generating stations in the low-flow period, but it is usual to keep some steam capacity floating on the line, especially in the severe lightning season, and thus use the steam plant as insurance against protracted interruptions of service.

First Interconnection Made

In 1921 the Alabama Power Co. and the Georgia Power Co. joined their systems by a 110,000-volt line from Gadsden, Ala., to Lindale, Ga. Since the construction of this line the loads and the power generation of the Alabama Power Co. system are influenced by the load and the power generation of the Georgia Power Co. The connection proved immediately advantageous to both companies, because it permitted the Alabama Power Co.'s mine-mouth steam plant at Warrior River to operate at 100 per cent load factor, 24 hours a day, the surplus power above that required in Alabama going into the Georgia company's system, where it could be absorbed at night, as this company had ample storage capacity and so could completely shut down its hydro-electric plant after the peak-load hour in the evening.

Eastern Georgia and the Carolinas are one hour ahead of Tennessee and Alabama, and this caused a difference in the time of the peak on the different systems. The Georgia and Carolina companies' industrial load being very largely cotton mills, their annual load factors are in the neighborhood of 33 per cent, whereas the Alabama and Tennessee companies, with a mining and a more diversified industrial load, have load factors of about 57 per cent.

Interchange of power among the Southeastern power companies proved so successful that executives of the various companies decided that still closer co-operation would be beneficial. An operating subcommittee was formed, with one representative from each company's operating department. This committee meets once a month, exchanging information concerning load and rainfall conditions, energy generated on each system by hydro and steam, and discusses such matters as voltage regulation, load dispatching and system protection. The work of this committee has proved of definite benefit. In natural sequence an engineering subcommittee was formed, consisting of a chief engineer or executive engineer of each company, and studies were made of the possibilities of a co-ordinated development program. These studies showed that close co-operation would permit a curtailment in the construction program of the individual companies, better use of hydro plants in operation and greater savings in steam generation.

ECONOMIC relations between electric energy produced in water power and in steam plants, and the conditions under which the two systems may work together to advantage in producing power at the lowest cost, as discussed in one of the American papers at the Basel Power Conference.

Data were assembled on stream flow, rainfall and run-off, load curves plotted for both wet and dry seasons, and the growth of each company's load projected for ten years and the proper sequence of development to carry the loads determined. While the proximities of the various systems and the necessarily restricted locations of large steam reserve plants, may make this a more immediate problem to the Southeast, we believe the principles involved are applicable to advantage elsewhere.

Agreement Between Companies

The type of agreement among the interconnected companies is largely responsible for the most economic generation and distribution of energy. Interchange contracts under which one company supplies power at night at one rate and gets it back in the day time at a higher rate, are common. Nearly all interchange contracts are optional on both parties; that is, if A has power to sell, and B desires to buy, power moves, otherwise not, and vice versa. With the contract signed and the line built, it becomes the operating department's job to carry out the contract and get the power over the line.

Many interesting features occur in the operation of interconnected systems. For example, the tie line between Gadsden and Lindale is a single-circuit wood-pole line 55 miles long, with a normal rating of 20,000 kw. At times 40,000 kw. load has been successfully carried over the line.

Use of Synchronous Condensers

Synchronous condensers are installed on the various systems for power-factor correction. These condensers are located near the load centers to secure the maximum possible benefit of power-factor correction. The Alabama Power Co. has installed a 25,000-kva. turbo-generator at its Gorgas steam plant, with provisions for disconnecting the generator from the turbine and operating the generator as a synchronous condenser. This is especially desirable, since in the wet season the steam plants are shut down, and as the hydro plants are located in the opposite section of the system, operation of the generators as condensers materially improves conditions throughout the system. During the dry season hydro-generators are floated for power-factor correction. By shutting the wicket gates, and breaking the vacuum in the draft tube on the machine, it is possible to operate generators for power-factor correction, with only a small loss of water. This same practice is followed by other companies on the interconnected network, and the systems supplying energy are released so far as possible of excess reactive load by systems receiving the energy, these systems using their spare generator capacity for power-factor correction.

To operate transmission systems successfully in parallel and at the same time secure the proper load adjustment among the various generating stations and among the systems themselves, it is essential that the frequency be rigidly maintained as 60 cycles. It has been found that the regulation of frequency must be controlled by the base-load stations, and especially the base-load stations of the system supplying the bulk of the power, all other stations making the necessary governor adjustment to follow in step. The governors at all stations taking the load fluctuation should be equally sensitive, so that all systems can properly carry their share of the fluctuation.

Supplying the Base Load

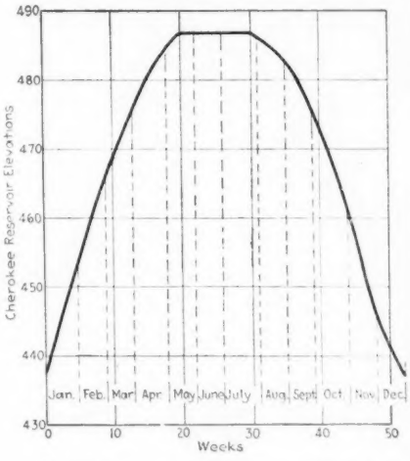
On the system of the Alabama Power Co. the base load is carried by the hydro plants and load fluctuations by steam plants in the wet season, and vice versa in the dry season. During the wet season, therefore, the frequency is controlled at lock No. 12 and at Mitchell Dam, and in the dry season it is controlled at the Gorgas steam plant. Master clocks are installed at both stations for this purpose. There is no

*Vice-president Alabama Power Co.
†Professor of mechanical engineering, University of Alabama.

appreciable difference in the manner in which hydro and steam stations handle load fluctuations.

When operating in conjunction with run-of-river hydro plants, the output of a storage hydro-electric plant may be increased by operating it by a rule curve, as shown in the figure. This curve consists of an established set of minimum pond elevations for the period of a year, below which the reservior water surface should never be drawn until all other sources of energy have been utilized. The rule curve not only controls the drawing of the reservoir so as to meet the system load in the worst low-flow year on record, but also regulates the output so as to use as much of the available storage in the dry season of each year and at as high a head as possible, so as to give the maximum energy output.

Capital costs of large steam plants are influenced by location and the economy for which the plants are built; they range from $90 to $140 per kilowatt capacity. Capital costs of hydro



Yearly curve of reservoir levels

plants vary so widely with location that no general costs are representative. Estimates made for three plants show that for a 70-ft. head 105,000-hp. run-of-river plant, with 84,000 hp. installed, the cost would be $77 per horsepower for the capacity in place. In a second run-of-river plant, to operate under the 95-ft. head, designed for 130,000 hp. and with 104,000 hp. installed, the cost would be about $76 per horsepower. For a plant of the same capacity as the second station, but to operate under a 140-ft. head and supplied from a large reservoir, the estimated cost was $109 per horsepower.

Muscle Shoals Cost of Power

The influence of a storage reservoir and of a steam plant on the cost of electrical energy from a run-of-river plant is well shown by the conditions at Muscle Shoals.[1] The initial capacity installed at Muscle Shoals is 184,000 kw. at 80 per cent power factor. The estimated cost of this plant less step-up transformers is $37,000,000 after deducting $9,000,000 as a charge against the improvement to navigation and allowing no interest charges during construction. At nitrate plant No. 2 the steam plant has installed 56,500-kw. capacity at 80 per cent power factor, with space for an additional 26,700-kw. unit, for which the foundations are in place. The present value of this plant may be taken at $6,000,000. At Muscle Shoals, with rare exceptions, the flow of the river may be taken at 8,400 sec.-ft., which, under the conditions prevailing at Wilson Dam plant, will generate 66,000 kw. This makes it possible to carry a 24-hour load of 122,500 kw. on the two plants.

Including all operating charges and allowing 4 per cent capital charge on the foregoing costs and setting aside a sinking fund of $700,000 per year,[2] the cost of 24-hour continuous power at Muscle Shoals is $24.53 per kilowatt-year, or $18.30 per horsepower-year. If the additional 26,700-kw. unit is installed in the steam plant at a cost of $1,000,000, a total continuous load of 149,200 kw. can be supplied from the two plants, and the cost per kilowatt-year will decrease to $23.03, or $17.16 per horsepower-year.

Cove Creek Storage Reservoir

If the Cove Creek storage reservoir is constructed, the minimum flow at Muscle Shoals will be 18,000 sec.-ft., which will increase the minimum power at Wilson Dam to 121,500 kw., and plus the present steam capacity would make a total of 178,000 kw. of 24-hour power. Under this arrangement the cost per kilowatt-year would be $19.70, or $14.70 per horsepower-year. Installing the additional steam unit would increase the total continuous capacity to 205,000 kw., and the cost of power production becomes $20.15 per kilowatt-year, or $15.03 per horsepower-year. In the first case, installing the additional steam unit decreased the cost of power production, whereas in the latter the installation of the additional steam unit increased the cost.

As another example of the advantages to be gained by combination of steam and hydro-electric plants, a power company operating a system that will have a peak load of 600,000 kw. by 1930, finds that developing its system so that 400,000 of this will be carried on steam plants and 200,000 kw. on water-power plants, will result in an annual saving of $1,400,000 per year over all steam operation.

Conclusions

Many different factors affect economic balance between thermal and hydraulically produced electric energy. No general rule can be laid down. Each system or group of systems presents its own peculiar problems. The number, size and availability of hydro-electric sites, and the necessity of developing them as a matter of public policy and fuel conservation, may frequently outweigh any temporary advantage there may be on the side of the thermal plant.

On the other hand, the advanced improvement in boiler and turbine efficiency, the possible development of the mercury turbine, all tend to make the thermal plant a producer of energy at as low unit cost as any, except the most favorably located, hydro-electric plant. As long as coal is the prime source of heat, the thermal plant faces certainty of increasing costs so far as this item is concerned.

For the territories with which the writers are most familiar, it would seem that, for the next ten years at least, the cheapest over-all cost of energy will be attained by developing the hydro-electric plants considerably beyond their primary-power capacities and supplementing these by economic steam plants located either at mine mouths or at important load centers.

A New Rating for Electric Motors

At the recent meeting of the Association of Edison Illuminating Companies, held in Quebec City, L. L. Elden presented a paper on "Motor Ratings and Their Applications Under Present Standards." The earlier method of rating motors was to allow a 40 C. temperature rise above an ambient temperature of 40 deg. and a 25 per cent overload rating for two hours. Then the 50 deg. C. rise rating came into use. This was followed with a rating based on a 40 deg. rise with no overload specified. The new rating is based on a 40 deg. rise, but allows the use of a service factor to increase the capacity of the motor under suitable conditions. According to the Electric Power Club Rules, "When authorized by the manufacturer, a service factor of 1.15 may be applied to 40-deg. open-type general-purpose motors larger than fractional horsepower sizes, when operated at rated voltage and frequency."

Among the favorable results expected to be attained through the use of the service factor to supplement present ratings are:

1. Manufacturers can concentrate on a single product. Assurances have been given that under these conditions the future cost of 40-deg. motors will be favorably affected.

2. The user can purchase safely motors more nearly corresponding to his actual requirements, thereby effecting a saving in the initial investment.

For example, it will no longer be necessary to purchase a 15-hp. motor when only 12-hp. capacity is required.

Assuming that service conditions are favorable, a 10-hp. motor utilizing the "service factor" would be adequate capacity for the desired service.

The net results of the purchase of the smaller motor would include a saving in the first cost of motor and starter, or controller, if used, a possible reduction in cost of wiring, a saving in operating costs due to better efficiency of the motor under higher loading conditions, and in some cases avoidance of power-factor penalties now included in many companies' rate schedules.

[1] Although the figures may show how the cost of power is affected by variation in the size of the water-power and steam plants, they are probably open to question as to the actual cost of power produced at Muscle Shoals. When everything is charged against this development that should be, the cost will be considerably higher than the figures given.—Editor.

[2] Interest figured at 4 per cent; sinking fund so as to return the investment in masonry in 50 years; in dam gates in 20 years; in electrical and hydraulic equipment in 25 years.

News in the Field of Power

Buffalo Convention To Mark Progress in Welding

Coming in the last quarter of a year of marked progress in the art of fusion welding, the annual fall meeting of the American Welding Society, which will be held in Buffalo, Nov. 17, 18 and 19, will direct attention to recent developments in apparatus, methods and applications.

The opinion has been expressed by members of the American Welding Society that the welding industry is already in the early stages of a development destined to rival that of radio. Like radio, welding has been used for years to a limited extent, but only recently has it become a prominent factor in all branches of industry. This meeting is designed particularly to acquaint the industry and the general public with the progress already made and to point the way to further advances.

A special session has been arranged for a discussion of the place of welding in the curricula of universities. It is expected that the frank discussion of the subject by a group of college professors interested in welding, and by leaders in the industry, will accelerate the movement to give welding and riveted joints equal consideration in the courses in machine and structural design.

The recently renewed popular and engineering interest in the welding of structural steelwork as a means of eliminating the noise of riveting and permitting the use of lighter structural members, will be capitalized by a special session in which structural steel men wil be invited to hear and discuss the latest developments along this line.

A special feature of the meeting will be a demonstration of the hydrogen-arc welding process described in the March 23 issue of *Power*. Other sessions will be devoted to the organization of welding on the railroads and to the accomplishments of the American Bureau of Welding, the research department of the Society.

The local committee, under the Chairmanship of Gideon W. Swan, Morgan Building, Buffalo, has already signed up about sixty exhibitors for the International Exhibition of Welding and Cutting to be held at the Broadway Auditorium in connection with the meeting.

Att.-General Ottinger Ill—Adirondack Hearing Off

Although Jacob G. Schurman, Jr., representing several Adirondack civic organizations, protested strongly against an adjournment of the hearing scheduled for Oct. 5 before the New York State Water Control Commission on the creation of the Salmon River regulating district, the hearing went over indefinitely, owing to the illness of Attorney-General Ottinger, who had informed Chairman Roy G. Finch that he wished to attend it.

Mr. Schurman represented opponents of the plan to create the regulating district.

Chief advocates of the project are the Malone Light & Power Co. and communities along the Salmon River. The opponents include the Saranac Lake Chamber of Commerce and the Adirondack Property Owners' Association.

German Power Engineers Here on Inspection Tour

A representation body of the German Association of Power Plants arrived at New York City Oct. 7, on the first stage of a comprehensive inspection tour of steam and hydro-electric power plants throughout the United States as far west as St. Louis.

The delegates—eight in number—are representatives of the leading power utilities and equipment manufacturing firms of Germany, which constitute the association.

The first visit of the trip was made to the East River station of the New York Edison Co. Oct. 8 on the same day, Dr. Calvin Rice, president of the American Society of Mechanical Engineers, was host to the party at a reception of welcome at the Engineering Societies Building.

Following a luncheon given by the Superheater Co. at the Engineers Club, inspection was made of the Hudson Avenue station of the Brooklyn Co. On the following Monday J. W. Lieb, vice-president and general manager of the New York Edison Co., welcomed the party in a tour to the Sherman Creek and Waterside stations.

On Oct. 13 the delegation will entrain for Boston, and thence westward. Plants at Buffalo Niagara Falls, Detroit, Chicago, Milwaukee, St. Louis, Cincinnatti and Philo, Ohio, Pittsburgh, Washington and Philadelphia will be touched before the return to New York for departure, about Nov. 10.

Although the tour of this country is for inspection solely, in the study of American methods and installations, General Director Dr. M. Krone, of Dortmund, will present a paper before the American Society of Civil Engineers at Philadelphia, Nov. 5.

Other members of the party are Dr. R. H. Mueller, of Berlin; Dr. X. Mayer, of Stettin; Director K. Merbitz of Siegen; Dr. R. Krone, of Dortmund; Dr. M. Fischer, of Dortmund; Dr. H. Schneider, of Berlin, and Dr. W. Dukmer, of Stettin.

Farm Bureau, Also, Demands Prompt Shoals Action

The American Farm Bureau Federation, after inspecting the Muscle Shoals properties, have made a unanimous demand that "Congress be urged to take immediate action for placing Muscle Shoals properties into operation."

The board's position was outlined further as follows: "No action was taken by the board of indorsing any of the existing proposals for the disposition of this project. The directors confirmed their demand for immediate development of the project for the manufacture of fertilizer in times of peace and for production of war materials in times of war.

"A desire on the part of the directors to hold the organization free from definite commitment, in the face of proposed new bids and changes in existing proposals, withheld indorsements.

"The Board does not wish to tie its hands only to have a superior proposal submitted subsequently which in nature of things it could more heartily endorse as more nearly meeting its approval in the matter."

Merger Forms Arkansas Power & Light Biggest in State

The largest utility organization to be incorporated under Arkansas laws has been formed to consolidate a group of properties supervised by the Electric Bond & Share Co. The new organization is known as the Arkansas Power & Light Co. and has an authorized capital of 1,300,000 shares of common, 150,000 shares of $7 preferred and 100,000 shares of $6 preferred stocks, all without par value.

It is planned to merge in the new company the present Arkansas Light & Power Co., Arkansas Central Power Co., Pine Bluff Co., East Arkansas Power & Light Co. and other properties. These companies are now controlled by the Electric Power & Light Corp., which will control the new company. Their stockholders are to vote on the merger at meetings to be called soon.

H. C. Couch, now president of Arkansas Light, is expected to be president of the new company. C. J. Griffith, vice-president and general manager of Arkansas Central Power, and J. L. Longino, vice-president and general manager of Arkansas Light, will be vice-presidents. Other officers will be former officials of the three companies named in the merger.

Practically all properties in the merger are already interconnected. The new company will supply electricity to about one hundred communities spread over a large area of Arkansas.

N. R. Gibson, Engineer, Now a Niagara Falls Power Head

Norman R. Gibson, who succeeded the late John L. Harper as chief engineer of the Niagara Falls Power Co., has been made a vice-president.

Mr. Gibson joined the staff of the Niagara Falls Power Co. Feb. 1, 1918, as hydraulic engineer. He was closely associated with Mr. Harper in his work, and following Mr. Harper's death was acting chief engineer. He was made chief engineer on Feb. 12, 1926, and as a result of work well done in that position he was elected vice-president.

Mr. Gibson has long been identified with the power-development projects at Niagara Falls. Graduating in civil engineering from Toronto University in 1904, he joined the Ontario Power Co. organization as draftsman. The following year he worked with the Niagara Falls Hydraulic Power & Manufacturing Co. as structural design engineer, and later in western Canada as assistant engineer on the Point du Bois development for the City of Winnipeg. A year later he was in Brandon, Manitoba, as engineer in charge of construction of the First Street bridge over the Assiniboine River. A position in charge of the civil and hydraulic engineering departments of Kerry & Chace, consulting engineers, of Toronto, followed this, and in 1915 Mr. Gibson returned to Niagara Falls as chief engineer of the Ontario Power Co. on the Canadian side. He later became hydraulic engineer of the Hydraulic Power Co. of Niagara Falls, N. Y.

He is the inventor of the Gibson method and apparatus for measuring the flow of liquids in closed conduits which has been accepted by the U. S. Geological Survey, the Federal Power Commission, the Dominion of Canada, and other governing bodies interested in the measurement of water used for power development.

Washington Water Power Co. Pushes Chelan Project

Drilling and excavation for the large tunnel being built by the Washington Water Power Co. for its Chelan hydroelectric project is up to schedule and more than half completed, according to construction reports received recently by the general manager, M. W. Birkett. A total of 5,917 ft. of tunnel heading and 5,796 ft. of the base have been excavated, leaving 5,587 of heading and 5,703 ft. of base yet to go.

Excavation for the power station near the junction of the Chelan River with the Columbia is said to be moving satisfactorily. Work on the power house is within sight of the Oroville branch of the Great Northern.

Jersey Central Power Buys Pompton Lakes Plant

The Jersey Central Power & Light Co., a national public service corporation, announced Oct. 5 the purchase of the Pompton Lakes New Jersey municipal hydro-electric plant, distribution system and meters, subject to a referendum to be held in November. The company has 750 consumers and the sale will carry with it a 50-year franchise. The Common Council, in accepting the Jersey Central's bid, stated that the municipality had lost money on the plant and could buy power cheaper.

Ontario Lauds St. Lawrence Plans of N. Y. Commission

Plans of the New York State Water Power Commission for the development of the international reach of the St. Lawrence River, have been received with favor in Ontario. The Hydro Electric Power Commission of that province has issued a statement in which gratification is expressed that the interests of the province have been fully recognized by the New York State Commission. After referring to the necesity of co-operation between the province and New York State, the Commission in its statement says:

"The New York State authorities sought by conference to facilitate the establishment of this basis of co-operation, which efforts had been heartily welcomed by the Hydro Electric Power Commission and any steps that will further the development of the powers in the international stretch of the St. Lawrence river will receive the hearty support of the Commission. The Commission is pleased to note that our neighbors have moved in this matter, and it is hoped that before long something definite will be decided upon, looking to the development of the St. Lawrence River powers. It is indeed gratifying to the Commission to know that the interests of Ontario have been fully recognized."

Duty on Engine Indicators Put at 40 Per Cent

In granting relief to the Bacharach Industrial Instrument Co. of Pittsburgh, the United States Customs Court at New York finds that certain indicators for use in connection with steam and gas engines, are correctly classifiable as manufactures of metal not specially provided for, at 40 per cent ad valorem under paragraph 399, tariff act of 1922.

The action of the collector in levying duty under the provision in paragraph 368, for devices or mechanisms having essential operating features for measuring time, distance, fares, etc., at a higher rate, is therefore set aside by Judge Fischer.

Finds Spanish Quicksilver Mine Wants Big Prices

At the Almaden quicksilver mine, in the province of Ciudad Real in Spain, Mr. Van Siclen, assistant chief mining engineer of the Bureau of Mines, on the occasion of a recent visit found great interest in the mercury boiler. If that invention should come into general use, all the quicksilver needed would be available in the Almaden mine, Mr. Van Siclen believes.

There was no evidence of a disposition to encourage this new use of mercury by making the material available at the lowest possible price commensurate with a medium profit. On the contrary, were there to be any sharp increase in the demand for quicksilver, he would expect rather to see the price advanced to the highest point the traffic would bear. Under such circumstances he would not be surprised to see an accord negotiated which would include the two mines in Italy.

"Soviets Able"—Cooper May Be Consulting Engineer

"The pendulum in Russia is swinging back slowly to sound ideas that will be acceptable to America," declared Col. Hugh L. Cooper, consulting engineer, who returned to his home in New York, Oct. 2, from a business mission in Russia.

Colonel Cooper, who was chief engineer of the Muscle Shoals project and of the Keokuk Dam, has been investigating a proposed large hydro-electric project on the Dnieper River for the Soviet government. The service was rendered pursuant to a contract entered into last June with Soviet representatives in New York.

"This project," Colonel Cooper said, "includes railway and other facilities that will cost about $75,000,000 and develop about 600,000 hp. I have recommended that $60,000,000 be spent on it in five years, and the recommendation probably will prevail. I have been asked by the Soviet government to become consulting engineer for the work, and I hope to be able to do it.

"The men at the head of the government impressed me as being strong and able. Everywhere I found that the eyes of Russia are looking to America for assistance and encouragement. We have there great opportunities for the world's upbuilding, as well as reasonably profitable trade."

Montpelier & Barre L. & P. Co. Up for Purchase

Rumors that the Montpelier & Barre Light & Power Co. would be taken over by other utility interests have crystallized into fact, according to the *Boston Transcript*. An announcement is being sent to the stockholders of the company apprising them of such a projected change in control.

The name of the purchasing interests is not known at this time, although rumors have linked the Insull group with the negotiations.

Ninety-ninth Florida Town Joins Superpower System

The Delray municipal electric power plant was taken over by Florida Power & Light Co. on Oct. 1, according to the announcement made by C. H. Ellis, district manager of the West Palm Beach district, in which Delray is located.

By a majority vote the freeholders of Delray approved the action of the city council to sell their municipally owned power plant to the Florida Power & Light Co. The consideration was $300,000. Mr. Ellis stated that Delray is the ninety-ninth city or community to come into the family of the Florida Power & Light Co.'s superpower service system.

Sees Remedy of Industrial Ills in Future Restriction

"There is taking place in the United States today a new industrial revolution which may far exceed in economic importance that older industrial revolution ushered in by the series of mechanical inventions which occurred in England in the last quarter of the eighteenth century, and which eventually transformed English industrial, political, and social life." The foregoing sentence from the *Monthly Labor Review* of the Department of Labor has evoked an amazing amount of comment and a great deal of inquiry as to its implications.

"This statement was well considered before it was put in print and given to the public," declared Ethelbert Stewart, chief of the Bureau of Labor Statistics, Department of Labor. "We are in the midst of a new industrial revolution, which apparently will exceed in economic importance the older industrial revolution that eventually transformed not only England's industrial, political and social life, but that of the entire Occidental world, if not the whole world.

"One of the first statistical warnings that something revolutionary was happening was the realization that production in various lines of American industry was rapidly increasing without a corresponding increase in employment. The volume of manufacturing output from 1921 to 1925 increased about 62 per cent; employment, according to one authority, increased only 14.28 per cent. Find, for example, that the revised figures for the automobile industry show that the output per man in 1925 was three times as great as in 1914, an almost incredible increase in productivity in an industry which attained even before 1914 a high state of efficiency. In fact, I believe it would not be far wrong to say that back in 1914 it was considered that the automobile industry had reached the pinnacle of productive efficiency, and yet each man employed in that industry produces three times as much now as he did in 1914. The increase in per capita production is due not only to increasing skill of management, improved machinery, abundant capital and so on, but is, undoubtedly, very largely due to the great energy and concentration and better will put into his work by the average workman.

"This revolution begins where the old revolution stopped. It imagines no end to the extension of the enslavement of the latent physical and chemical powers of the world. The United States literally lives in a future age, compared even with some of the most highly civilized nations. So great is our advance in these last years' production that our problem in the near future is likely to be one of consumption. How can we market the enormous volume of goods we are capable of producing? I have an idea that the full-time productive capacity of the manufacturing industries of America, with but little increase of employment, is already about 40 per cent larger than the present market.

"To some extent we shall find an outlet for this surplus productivity of our people in foreign markets, but it seems highly probable that we shall have to enjoy part of our surplus productive capacity in cultural dividends. As we are now producing more than we can consume, we will be tempted to restrict production. That can be done, rather brutally, by complete suspension of industrial activity in the different industries for a longer or shorter time; or it can be done by part-time suspension."

Detroit Edison Installs New Dust-Removal Equipment

After an extended study of an experimental installation, embodying new features in design and construction, The Detroit Edison Co. has decided to install electrostatic precipitation equipment to remove pulverized-coal ash dust from the gases entering No. 4 track at the Trenton Channel power plant, in the extension now under construction. The new design has proved highly successful in overcoming the difficulties encountered in operating the original units.

Colorado Power Co. Organizes in San Francisco

The Colorado Power Co., organized in San Francisco to generate and sell electric power, has filed articles of incorporation with the California Secretary of State. Directors of the $500,000 concern are: Albert P. Slichter and Charles W. Backe of San Francisco and John R. Selby of Palo Alto, Calif.

Obituary

Virgil Poston, for the past eight years superintendent of operations for the New York & Queens Electric Light & Power Co., Long Island City, died at his home in Bayside, Long Island, Sept. 22. Previous to his connection with the New York & Queens utility Mr. Poston had been identified with the American Gas Co., the Waukesha Gas & Electric Co. in the capacity of chief engineer and with the Milwaukee Electric Railway & Light Co. from 1917 to 1918. He was a native of Bonne Terre, Mo., and a graduate of the University of Wisconsin.

Frank C. Armstead, who had been identified with the Westinghouse interests since 1888, died Sept. 7. His name will always be linked with the production of the mechanical stokers, as he was identified with its pioneering, and later with its development, during the greater part of a long career. In recent years he had been acting in an advisory capacity. After some years of mechanical and operating experience, he joined Westinghouse, Church, Kerr & Co., first as an erecting man, later becoming superintendent of construction. He went in 1903 to the Westinghouse Machine Co. in complete charge of the stoker department's engineering and installation work.

Personal Mention

F. W. Leahy, chief engineer of the Campbells Creek Coal Co., Cincinnati, Ohio, has been appointed manager of transportation for that company.

Prof. Lester P. Breckenridge, long noted as a leader in the field of mechanical engineering, sailed for Italy, Oct. 9, accompanied by Mrs. Breckenridge.

Albert B. Alsos, formerly in the power machinery division of the Bethlehem Shipbuilding Corp., is now an engineer in the power division of Stone & Webster, Inc.

George R. Fulton has recently joined the organization of Stone & Webster, Inc., as an engineer in the power division. Mr. Fulton was assistant chief engineer with the Galveston-Houston Electric Railway Co.

C. C. Chesney, president of the American Institute of Electrical Engineers and vice-president and general manager of the Pittsfield works of the General Electric Co., is visiting the northwest sections of the A.I.E.E., delivering illustrated talks and lectures on the development and manufacture of some of the latest power-plant equipment.

H. Burgi, Jr., for the past ten years power engineer of the Cumberland County Power & Light Co., Portland, Me., resigned Oct. 1 to join the organization of George F. West & Son, public utility operators, Portland. Mr. Burgi is a graduate of Columbia University. Previous to his connection with the Cumberland County company he was for a time employed by the General Electric Co. and the Public Service Corp. of New Jersey.

Society Affairs

The Newcomen Society, will hold a general meeting on Wednesday, Oct. 20, at the Iron and Steel Institute, 28 Victoria St., London S.W. 1, England, when Rhys Jenkins, president, M. I. Mech. E., will deliver his presidential address entitled "Observations on the Rise and Progress of Manufacturing Industry in England." The succeeding meeting in November will be the annual general meeting, when the election of officers for the ensuing year will take place. Nominations should be sent to H. W. Dickinson, Hon. Sec., The Science Museum, London S.W. 7, England. A paper will be presented by Charles R. King, dealing with Perkins and high steam pressures.

Business Notes

The Link-Belt Co. of Philadelphia is represented in Baltimore, Md. by Gilbert H. Unruh, who, for the present, may be reached at 618 Regester Ave., Stoneleigh, Baltimore County, Md. (Govans P. O.).

The Northern Equipment Co. of Erie, Pa., manufacturer of the Copes system of boiler-feed control, announces the appointment of the Hoshall Machinery Co., of Memphis, Tenn., as representatives for Tennessee and northern Mississippi.

The Timken Roller Bearing Co. announces that R. C. Brower has recently been appointed general manager. Mr. Brower will make his headquarters in Canton, Ohio, at the main plant of the company, but will devote a great deal of his time to maintaining contact in the field.

W. L. Ticer, consulting mechanical engineer on the design and supervision of heating and ventilating for power plants, of Washington, D. C., is associated with Col. P. M. Anderson, consulting engineer and architect, at offices in the Investment Building at 15th and K Sts., N. W., for engineering services on mechanical equipment of buildings with reference to heating, ventilating, power plants, plumbing, refrigeration, supervision, investigations and reports.

Belting, Transmission and Accessory Manufacturers are progressing in their movement to form a new association through the work of the Survey Committee appointed at a meeting held June 10. The Survey Committee met at the Old Colony Club, Waldorf Astoria, New York City, Sept. 14. Reports of the chairman and secretary indicating a great deal of interest in the movement among manufacturers of this group were submitted, and the matter of further procedure was taken up in considerable detail.

The Power Plant Supply Co., Widener Bldg., Philadelphia, announces that it is in a position to furnish power plants in Philadelphia and vicinity promptly with the products of the following manufacturers at standard prices: J. E. Lonergan, steam specialties; Dixon greases; National Carbon brushes; Ohio grease and oils; Rhoads belting; Howell motors; Graybar lamps and electrical supplies. The activities of the company will be divided between two departments. One of these, the supply department, will act as jobbers or agents for power-plant supply equipment. The other, the engineering department, will handle the consulting and special service work of its customers.

Trade Catalogs

Gear Pumps and Steam Jet Syphons—the Schutte & Koerting Co., of Philadelphia, have new Bulletins Nos. 2-A and 17-A-9. The former is a revised edition of a similar section, while the latter is a new supplement to the company's existing gear pump bulletin No. 17-A.

Electric Portable Compressors—The Sullivan Machinery Co., in Bulletin 83-E, briefly describes Sullivan portable air compressors, operated by electric motors. These are available at present in two sizes, 103 ft. and 206 ft. machines. One of the first of these machines has just been on exhibit at the American Electric Railway Convention in Cleveland, October 4 to 8.

Steam Turbines—The Terry Steam Turbine Co., Hartford, Conn., has issued Bulletin S-80, devoted entirely to the Terry multi-stage machines which are built in sizes up to about 2,000 hp. Descriptions are given covering the various types together with the factors that govern their use. Typical installations are cited which illustrate a few of the many possibilities of securing low cost power as a byproduct of process steam.

Coming Conventions

American Engineering Council. Annual meeting at Washington, D. C., Jan. 13-15. L. W. Wallace, 24 Jackson Place, Washington, D. C.

American Welding Society. Annual Fall Meeting, at Buffalo, N. Y., Nov. 16-19. Gideon W. Swan, general chairman, Morgan Bldg., Buffalo. First International Welding Exposition will be held in conjunction with meeting.

Engineering Institute of Canada. Annual meeting Jan. 18. Richard John Durley, secretary, 176 Mansfield St., Montreal, Que.

Midwest Power Show, at Chicago, Feb. 15-19. G. E. Pfisterer, managing director, 53 West Jackson Blvd., Chicago.

National Association of Practical Refrigerating Engineers. Annual Convention and Exhibition at Kansas City, Mo., Nov. 2-5. Edward H. Fox, secretary, 5707 W. Lake St., Chicago, Ill.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Divisional meeting on the following date: Kansas Section at Manhattan, Kan., Oct. 14-16; H. Lee Jones, secretary, 401 National Reserve Bldg., Topeka, Kan.

National Exposition of Power and Mechanical Engineering. Fifth Annual Exposition at Grand Central Palace, New York City, Dec. 6-11.

National Marine Engineers' Beneficial Association. Fifty-third annual convention at Washington, D. C., Feb. 14. Albert L. Jones, secretary-treasurer.

Electrical Hoists—The American Engineering Co., of Philadelphia, has printed a new catalog on electric hoists. This catalog lists for the first time, six large, new hoists that have just been added to the Lo-Hed line. These hoists extend the range of capacities up to 24,000 lb. and add an entirely new class of hoists to those the company has already built. This makes four distinct classes of Lo-Hed hoists, each class being built in from two to six sizes and with various types of suspension and control, including bolt suspension, plain trolley, hand geared trolley, motor trolley and two types of cab hoists and the choice of pendant cord control, push button control, and remote control. When desired an extremely sensitive foundry control for the accurate handling of loads can be supplied. All Lo-Hed hoists are built for both a.c. and d.c.

Climax Engines—The Climax Engineering Co., Clinton, Iowa, is distributing a revised edition of its "Lubrication Instructions for Climax Trustworthy Engines," a comprehensive and elaborate treatise on the subject of proper lubrication of heavy-duty, medium-speed industrial engines.

The book was originally prepared by the technical staff of the Vacuum Oil Co. in collaboration with the engineers of the Climax Engineering Co. It has been brought up-to-date and amplified. It contains a large amount of information dealing with lubrication of Climax engines in all classes of service, together with recommendations of proper lubricants and directions as to their use. The book is well illustrated, with diagrams and halftones.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Oct. 4 1926
Pool 1	New York	$2.75@$3.00
Smokeless	Boston	3.10
Clearfield	Boston	2.10@ 2.75
Somerset	Boston	1.90@ 2.15
Kanawha	Columbus	1.75@ 2.15
Hocking	Columbus	1.40@ 1.75
Pittsburgh	Pittsburgh	2.00@ 2.15
Pittsburgh gas slack	Pittsburgh	1.35@ 1.45
Franklin, Ill.	Chicago	2.35@ 2.50
Central, Ill.	Chicago	2.15@ 2.25
Ind. 4th Vein	Chicago	2.15@ 2.35
West Ky.	Louisville	1.15@ 1.50
S. E. Ky.	Louisville	1.60@ 2.00
Big Seam	Birmingham	1.75@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1	New York	2.25@ 3.50
Buckwheat No. 1	Philadelphia	2.00@ 2.75
Birdseye	New York	1.40@ 2.00

FUEL OIL

New York—Oct. 7, light oil, tank-car lots; 28@34 deg. Baumé, 6c. per gal.; 36@40 deg., 6¾c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Sept. 28, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.15 per bbl.; 26@28 deg., $2.20 per bbl.; 28@30 deg., $2.25 per bbl.; 30@32 deg., $2.30 per bbl.; 32@36 deg., gas oil, 6.1c. per gal.; 38@40 deg., 7.5c. per gal.

Pittsburgh—Sept. 29, f.o.b. local refinery; 30@34 deg., fuel oil, 5¾c. per gal.; 36@40 deg., fuel oil, 6¼c. per gal.

Dallas—Sept. 22, f.o.b local refinery 26@30 deg., $1.70 per bbl.

Philadelphia—Sept. 30, 27@30 deg., $2.52@$2.58 per bbl.; 13@19 deg., $1.59 @$1.65 per bbl.

Cincinnati—Oct. 5, tank-car lots f.o.b. local refinery, 24@26 deg., Baumé, 6¼c. per gal.; 26@30 deg., 6⅝c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Sept. 25, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.45@$1.50 per bbl.; 26@30 deg., $1.60@$1.65; 30@32 deg., $1.80.

Boston—Oct. 4, tank-car lots f.o.b. 12@14 deg. Baumé, 4.8c. per gal.; 28@32 deg., 6c. per gal.

New Plant Construction

Ark., Blytheville—Drainage District 17, Mississippi County, will receive bids until Oct. 15 for a 2 unit 150,000 g.p.m. pumping plant. Pride & Fairley, Osceola, are engineers.

Calif., San Francisco—C. Heyer, Jr., et al. c/o H. C. Smith, Archt., Humbolt Bank Bldg., has had plans prepared for the construction of 14 story, apartment at Pacific Ave. and Buchanan St. Estimated cost $600,000.

Calif., San Francisco—Pacific Edgewater Club, c/o Reid Bros., 105 Montgomery St., is having plans prepared for the construction of a 7 story club building including ice skating rink, swimming tank, etc. Estimated cost $1,500,000.

Ill., Chicago—A. B. Allen, 134 North La Salle St., is having plans prepared for the construction of an 18 story apartment including electric refrigeration system, etc. at Devon Ave. and Sheridan Rd. Estimated cost $3,000,000. Frank D. Chase, Inc., 720 North Michigan Ave., is architect.

Ill., Chicago—Garfield Park State Savings Bank, 4004 West Madison St., is having plans prepared for the construction of 8 story, 75 x 175 ft. bank and office building on Madison St., near Crawford Ave. Estimated cost $800,000. D. H. Burnham Co., 160 North La Salle St., are engineers.

Ill., Chicago—A. L. Klewer, 220 South Michigan Ave., Archt., will receive bids until Oct. 15 for the construction of an 8 story apartment including electric refrigeration system, etc. at Pratt Blvd. and Sheridan Rd. for Pratt Blvd. Hotel Corp., c/o architect. Estimated cost $400,000.

Ill., Chicago—Sheridan Grace Building Corp., c/o B. L. Steif & Co., 307 North Michigan Ave., Archt., awarded contract for the construction of a 16 story apartment at Sheridan Rd. and Grace St. to Avery Brundage Co., 110 South Dearborn St. Estimated cost $3,000,000.

Ill., Chicago—Wm. L. Wallen & Co., 6712 North Clark St., is receiving bids for the construction of a 17 story apartment including central refrigeration plant, etc. at 405 Fullerton Parkway. Estimated cost $1,500,000. R. F. France & Co., 155 North Clark St., are architects.

Ill., La Grange—Nazareth Academy, awarded contract for the construction of a school including central heating plant, to W. J. Lynch Co., 844 Rush St., Chicago. Estimated cost $500,000.

Kan., Osawatomie—Missouri Pacific R.R. Co., Railway Exchange Bldg., St. Louis, Mo., awarded contract for the construction of a power house here to J. R. Van Sant, 417 Dwight Bldg., Kansas City, Mo. Estimated cost $25,000.

Mass., East Cambridge (mail Boston)—Middlesex County Jail, A. Cutting, Court House, Cambridge, is having plans prepared for the construction of a boiler house. Estimated cost $160,000. Edward C. Brown Co., 220 Devonshire St., Boston, is engineer.

Mich., Detroit—Chrysler Corp., C. C. Sherk, Highland Park, awarded contract for extension to motor plant including boiler house, etc. here to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost $250,000.

Mich., St. Johns—Clinton Memorial Hospital Assn., S. L. Marshall, Secy., will soon award contract for the construction of a 2 story hospital including separate power plant. Estimated cost $150,000. R. V. Gay is architect.

Miss., Pascagoula—Mississippi Ice & Utilities Co., will build an addition to ice plant by day labor. Estimated cost $40,000. Ice and refrigerating machinery, new crude oil burning engine, etc. will be installed.

Mo., Seymour—City will soon receive bids for the construction of a waterworks system including deep well, pumping equipment, tank on tower, etc. Estimated cost $35,000. A. H. Kendrick is engineer.

N. H., Concord — St. Paul's School, J. Walker, Bus. Mgr., is receiving bids for the construction of a power plant on Dunbarton Rd. French & Hubbard, 210 South St., Boston, Mass., are engineers.

N. J., Keyport—City, plans the installation of pumping machinery, oil burning engines, etc. in pumping station. Estimated cost $28,470. A. Wyckoff, mayor.

N. J., Newark—City Comn., C. Gillen, Director, will readvertise for bids for the construction of a boiler house at City Hall. Estimated cost $200,000. Former bids rejected.

N. Y., Middletown—State Hospital Comn., Albany, will receive bids until Oct. 27 for furnishing and installing new boiler and equipment at Middleton State Hospital here.

N. Y., New York—Allerton Hotel Co., 285 Madison Ave., plans the construction of an 18 story hotel at Lexington Ave. and 63rd St. Estimated cost $2,500,000.

N. Y., New York—One Thousand Sixteen Fifth Ave. Co., Inc., A. Sokolski, Pres., will build a 14 story apartment at 5th Ave. and 83rd. St. by day labor. Estimated cost $900,000. J. B. Peterkin, 285 Madison Ave., is architect.

N. Y., New York—J. Paterno, 601 West 115th St., will build a 23 story apartment on 5th Ave. Estimated cost $3,000,000. J. E. R. Carpenter, 598 Madison Ave., is architect. Work will be done by separate contracts under the owner's supervision.

N. Y., New York—David Zimmerman, 1431 Broadway, plans the construction of a 15 story apartment at Park Ave. and 96th St. Estimated cost $1,250,000.

N. Y., St. George, S. I.—American Trust Co. and New York Title & Mortgage Co., 135 Broadway, New York, is having plans prepared for the construction of a 12 story bank and office building including steam heating system, 4 electric elevators, etc. Estimated cost $750,000. H. S. Luckman, 135 Broadway, New York, is architect.

N. Y., Utica—State Hospital Comn., will receive bids until Oct. 27 for furnishing and installing an electric generator at Utica State Hospital.

N. C., Badin—Tallassee Power Co., S. A. Copp, Mgr., awarded contract for the construction of a dam, etc., on the Yadkin River to develop 40,000 hp. to Southern Power Co., 432 South Church St., Charlotte. Estimated cost approimately $12,000,000.

O., Avon Lake—Bd. of County Comrs. Lorain County, will receive bids until Oct. 15 for the construction of a filter plant, low service pump house, pumping equipment, storage tank, etc. Estimated cost $200,000. G. B. Gascoigne, 1148 Leader News Bldg., Cleveland, is engineer. Former bids rejected.

O., Cleveland — The Phillis Wheatley Assn., J. E. Hunter, Secy., 2269 East 40th St., will soon award contract for the construction of a 10 story community center building including heating and power boilers elevators, incinerator, etc. at 4450 Cedar Ave. Estimated cost $800,000. Hubbell & Benes, Avenue Bldg., 4,500 Euclid Ave., are architects.

Okla., Eddy—City is having preliminary plans prepared for the construction of a waterworks system including deep well pump, 40,000 gal. tank on 80 ft. tower. Estimated cost $17,000. Engineer not selected.

Okla., Seminole—City, E. Magruder, Clk., will receive bids until Oct. 25 for improvements to waterworks including a new 250,000 gal. reservoir, deep well pump, motor driven centrifugal pump, etc. Estimated cost $65,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, are engineers.

Tenn., Lewisburg—Southern Cities Power Co., Provident Life Bldg., Chattanooga, is having plans prepared for the construction of a hydro-electric power plant and dam on Duck River here. Freeland & Roberts, Independent Bldg., Nashville, are engineers.

Texas—Central Power & Light Co., Frost Bldg., San Antonio, has acquired light and power plants at Wellington and Fredericksburg and is having surveys made for extensive improvements, also acquired ice plant at Comfort and plans improvements to increase the capacity from 25 to 40 ton. Estimated cost $70,000, $75,000 and $40,000 respectively. Machinery will be required.

Tex., Bay City—Texas Central Power Co., Frost Bldg., San Antonio, awarded contract for the construction of a 50 ton ice plant here to Gunderman & Allen, 445 Cooper St., San Antonio. Machinery contracts will be awarded later. Total estimated cost $75,000.

Tex., Brownsville—City plans an election Oct. 16 to vote $100,000 bonds for extensions to water and light plant. Engineer not selected.

Tex., El Dorado—City, C. A. Spencer, Mayor, is having plans prepared for improvements to waterworks and distribution system including pumping plant, etc. Estimated cost $40,000.

Tex., Laredo—Webb County Water Improvement Dist., G. S. Marshall, Chn. of Committee, plans to irrigate from 50,000 to 70,000 acres of land in Webb County, also the construction of a dam and pumping plant. Estimated cost $1,500,000.

Tex., San Antonio—Physicians & Surgeons Hospital c/o J. H. Cunningham, Dallas, is having plans prepared for the construction of 5 story hospital at Richmond and Camden Sts. Estimated cost $1,000,000. Phelphs & DeWees, Gunther Bldg., are engineers.

Tex., Terrell—City, J. R. Barnett, Secy., is receiving bids for a 225 to 360 hp. oil burning engine direct connected to 2-300 v., 3 ph., 60 cycle generator and exciter.

Tex., Wichita Falls—Western Textile Corp., c/o D. C. McIntyre, is having preliminary plans prepared for the construction of a cotton mill, probably electrically driven. Estimated cost $300,000. Private plans.

Va., Lynchburg—Bd. of Trustees of Elks' National Home, Bedford, will soon receive bids for the construction of a 200 hp. central heating plant here. Work will be done under the supervision of C. Jennings, V. Pres. of Board.

Wis., Chippewa Falls — Clover Leaf Creamery, 417 Bridge St., awarded contract for the construction of an ice cream factory and creamery to Ischopp-Durch-Camastral Co., High and East Columbia Sts. Estimated cost $40,000. Refrigeration machinery will be installed.

Wis., Madison—Oscar Mayer Packing Co., 1421 Sedgwick Ave., Chicago, Ill., is receiving bids for the construction of a cold storage plant here. Estimated cost $50,000.

Wis., Milwaukee—Schroeder Hotel Co., 86 Michigan St., is having plans prepared for the construction of a 23 story hotel on Grand Ave. Estimated cost $5,000,000. Holabird & Roche, 104 South Michigan Blvd., Chicago, Ill., are architects.

Wis., Park Falls—Mead & Seastone, Journal Bldg., Madison, Engrs., are having plans prepared for the construction of a hydro electric plant on Flambeau River. Owner's name withheld.

Wis., Pine River—Wisconsin Power & Light Co., 16 North Carroll St., Madison, awarded contract for the construction of a wheel house and plant here, to L. M. Weber, Emerald St., Madison.

Ont., Saulte Ste Marie—Spanish River Pulp & Paper Co., plans the installation of new electric pulp grinders, two steam turbine driven generators, etc. in pulp mill, also to rebuild boiler house and construct intake well. Estimated cost $700,000.

Ont., Toronto—City, F. Foster, Mayor, City Hall, will receive bids until Nov. 2 for a 1,500,000 gal. centrifugal pump for sewage station. Estimated cost $10,000. R. C. Harris, City Hall, is engineer.

N. Z., Wellington—Dept. of Public Works, Supplies and Tenders Board, will receive bids until Dec. 7, for one 3 ph. induction regulator to control voltage on the 6,000 v. side of a bank of transformers 750 kva. total capacity, 50,000/6,600 v. ratio, 5 cycle star connected on both sides.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are prices to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

MOST of the price changes since September, in power-plant and electrical supplies, were in a downward direction. Notable among the declines were those occurring in armored cable, rubber-covered copper wire, 15-watt lamps, linseed oil and refractories. Babbitt metal, various grades, advanced from 1 to 6c. per lb. during the month.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 74c. per ft.
Common, 2½-in., cotton-rubber lined	80c. per ft. list less	40%

Air—Best grade

¾-in., per ft.	3-ply	$0.37½	4 ply	$0.46

Steam—Discounts from List

First grade	30-10%	Second grade	40%	Third grade	40-10%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade	50%	Second grade	50-10%

LEATHER BELTING—List price, 24c. per lin ft. per inch of width for single ply at New York warehouses.

Grade	Discount from list
Medium	40-5%
Heavy	30-10%

RAWHIDE LACING—For cut, best grade, 50%, 2nd grade, 60%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 50%; sides, 41c. per sq.ft.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$1.05
Asbestos for high-pressure steam, ⅛ in.	1.85
Duck and rubber for piston packing	1.05
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.95
Wire insertion asbestos sheet	1.40
Rubber sheet	.60
Rubber sheet, wire insertion	.85
Rubber sheet, duck insertion	.65
Rubber sheet, cloth insertion	.30
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
For low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.50@$2.69 per bbl. without bags, in carload lots delivered on job. Bag charge of 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, 3 to 15-in. beams and channels and 3 to 6-in. angles, tees, and plates, all $3.34 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	13.00@17.50	18.00	15.00@20.00
Colored	10.00@14.00	14.00	12.00@17.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.15
New York	.17½
Cleveland (per thousand)	36.00

LINSEED OIL—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.85½	$0.98	$0.88

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Current	1 Yr. Ago	Current	1 Yr. Ago
Red	$15.25	$15.75	$16.75	$17.25
White	15.25	15.75	15.25	15.75

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Rivets, ⅞x1-in. and longer, 19c. per lb., less 50% at New York warehouses. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ½-in., dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Structural rivets, per 100 lb.:

New York	$4.20	Chicago	$3.50	Pittsburgh	$2.50@2.60

Cone-head boiler rivets, per 100 lb.:

New York	$4.40	Chicago	$3.70	Pittsburgh	$2.90

REFRACTORIES—Prices in carlots f.o.b. plant:

Chrome brick, eastern shipping points	net ton	$48@53
Chrome cement, 40@50% Cr_2O_3, in bulk	net ton	23@28
Chrome cement, 40@50% Cr_2O_3, in sacks	net ton	27@32
Magnesite brick: 9-in. straights	net ton	65@68
Magnesite brick: 9-in. arches, wedges and keys	net ton	71.50@74.80
Magnesite brick: Soaps and splits	per ton	91.00@95.20
Silica brick: Mt. Union, Pa.	per M	38@40
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@45
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	40@43
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	40@43
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	33@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	38@40
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	38@40
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	38@40
Chrome ore crude, 40@50%	net ton	19.00@20.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	88.00
Commercial genuine, intermediate grade	61.00
Anti-friction metal, general service	32.50
No. 4 babbitt (f.o.b.)	14.75

COLD DRAWN STEEL—Warehouse prices are as follows:

	New York	Cleveland	Chicago
Round shafting and screw stock, per 100 lb. base	$4.00	$3.90	$3.60
Flats and squares, per 100 lb. base	4.50	4.40	4.10

BOILER SPECIALTIES—F. o. b. New York or Jersey City, discounts on list

	Current
Copper ferrules	70%
Boiler flanges	65-5%
Boiler stay bolts	60%
Boiler patch bolts	10%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	12

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are prices in New York warehouse of tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17 07
1¼	.....	.....	19 20
1½	.....	$38 00	17 92
1¾	.....	28 50	20 48
2	$17 33	25 00	20 24
2¼	19 84	28 25	23 00
2½	21 60	34 00	26 03
3	25 50	42 50	27 04
3¼	30 25	49 50	30 67
3½	31 50	52 75	33 33
4	38 03	67 00	40 11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.

These prices are net per 100 ft. based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller, 5c. per cut. 3 in., 9c. per cut
2¼ and 2½ in., 6c. per cut. 3½ to 4 in., 10c. per cut

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid	$32 50 (net)	$ 51 00 (net)	$164.00	$210.00
No. 12 solid	135.00	170.00	225.00	265.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	285.00	375.00	520.00	500.00
No. 6 stranded	400.00	500.00	560.00	.....

From the above lists discounts are:

	Lead Covered
Less than coil lots—50%	20%
Coils to 1,000 ft.—60%	30%
1,000 to 5,000 ft.—60-5%	35%
5,000 ft. and over—60-10%	38%

CONDUIT, Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, Per 100 pieces, f.o.b. New York, with 10-day discount of 5 per cent.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56 50	$61 34	$7 76	$8.83	$4 52	$4.92
⅜	72.07	78.63	10 21	11 63	6 46	7.03
½	103 31	113.00	15 10	17 21	8 39	9.13
¾	139.77	152.88	20 51	23.07	11 78	12.75
1	167.12	182.79	27 34	30.76	14 56	15.75
1¼	224 83	245 94	50 13	56 40	19 41	21.01
1½	355 50	388 85	82 03	92 28	27 73	30.01
2	464 88	508 50	218 74	246 10	41 59	45.01
3	585 30	637 74	483 04	543 46	55 46	60.02
4	714 17	776 30	558 23	628 06	69.32	75 02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices each in standard-package quantities:

CUT-OUTS, PLUG, SOLID NEUTRAL OR 2 FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID NEUTRAL OR 2 FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$19.25
No. 16 cotton reinforced heavy		23.50
No. 18 cotton reinforced light		16.00
No. 16 cotton reinforced light		20.50
No. 18 cotton Canvasite cord		15.50
No. 16 cotton Canvasite cord		19.00
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$92.00	*101.20
No. 14 super service cord or similar (2 wire) in 1,000 ft.	133.00	*146.40

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100 amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less 1-5th standard package, 60%; 1-5th to standard package, 64%; standard package, 68%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4 00	5.00	25	5
225 to 400-amp.	7.50	11 00	25	1
450 to 600-amp.	11.00	16.00	10	1

REFILLS—

1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton	5%
Unbroken carton but less than std. pkg.	22%
Std. pkg.	40%
Discount Without Contract—Renewals:	
Less than std. pkg.	Net list
Standard package	40%
Discount With Contract—Fuses:	
Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%
Discount With Contract—Renewals:	
Less standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.75
0-30 ampere, less than standard package	3.00

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard A type bulbs:

100—130 Volt Watts	Type	Price Each	200—260 Volt Watts	Type	Price Each
				Special	
15	A 17	$0.25	25	A 19	$0.30
	General		50	A 21	.30
25	A 19	25	100	A 23	.53
40	A 21	25			
50	A 21	27			
60	A 21	30			
100	A 23	43			

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain separable attachment plug	$0.18
Composition 2-piece attachment plug	.27
Swivel attachment plug	.12
Small size—2 Pc. Plug—Composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Duplex
14	$6.25	$9.75	$11.60	$18.20
12	10.10	12.60	14.60	23.80
10	13.20	16.40	18.60	30.50
8	19.00	22.30	24.20	42.40
6	.....	.....	34.40	.....
4	.....	.....	48.00	.....
2	.....	.....	68.75	.....
1	.....	.....	94.70	.....
0	.....	.....	115.00	.....
00	.....	.....	138.00	.....
000	.....	.....	165.00	.....
0000	.....	.....	196.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	Keyless	Pull	¾ In. Cap Key	Keyless	Pull
Standard package.	$0.17	$0.15	$0.22	$0.20	$0.18	$0.25
Unbroken carton	.18	.16	.23	.22	.19	.26
Broken carton	.20	.18	.25	.24	.21	.28

WIRING SUPPLIES—

Friction tape, ¾ in., less 100 lb. 35c. lb., 100 lb. lots	33c. lb.
Rubber tape, ¾ in., less 100 lb. 37c. lb., 100 lb. lots	35c. lb.
Wire solder, less 100 lb. 29c. lb., 100 lb. lots	31c. lb.
Soldering paste, 2 oz. cans	$1.00 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25.00 to $50.0 list value	30-5%
$50.00 list value or over	35%